U. S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

CLASSIFICATION ORDER 1850

NOVEMBER 1, 2005

Project No. X-6877

The following classification changes will be effected by this order:

	Class	Subclass	Art Unit	Ex'r Search Room No.
Abolished:	977	DIG. 1	2811	ELEL0000
Established:	977	CROSS-REFERENCE ART COLLECTIONS	2891	Not Applicable
		700-963		

Class 977 is intended only to provide supplemental art collections for search and is not used as a basis for assigning patent applications for examination purposes to the listed examining art unit (2891). US patents or pre-grant publications can only be classified in class 977 as Cross-references (XR) or Secondary (SEC) classifications, and not as Original (OR) or Primary (PRI) classifications. The Art Unit is listed only for purpose of facilitating class consultation inquiries for this Cross-Reference Art Collection.

No other classes are impacted by this order.

This order includes the following:

A. CLASSIFICATION MANUAL CHANGES;

C. CHANGES TO THE U.S. - I.P.C. CONCORDANCE;

D. DEFINITION CHANGES AND NEW OR ADDITIONAL DEFINITIONS.

CLASSIFICATION ORDER 1850

NOVEMBER 1, 2005

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A. CLASSIFICATION MANUAL CHANGES

Additional and modified subclasses

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CROSS-REFERENCE ART COLLECTIONS
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700 NANOSTRUCTURE
701 .Integrated with dissimilar structures on a common substrate
702 ..Having biological material component
703 ...Cellular
704 ...Nucleic acids (e.g., DNA or RNA, etc.)
705 ...Protein or peptide
706 ...Carbohydrate
707 ..Having different types of nanoscale structures or devices on a common substrate
708 ..With distinct switching device
709 ...Including molecular switching device
710 ....Biological switching
711 .....Nucleic acid switching
712 ..Formed from plural layers of nanosized material (e.g., stacked structures, etc.)
713 ...Including lipid layer
714 ....Containing protein
715 ..On an organic substrate
716 ...Biological cell surface
717 ...Lipid substrate
718 ...Carbohydrate substrate
719 ...Nucleic acid substrate
720 ..On an electrically conducting, semi-conducting, or semi-insulating substrate
721 ...On a silicon substrate
722 ...On a metal substrate
723 ..On an electrically insulating substrate
724 .Devices having flexible or movable element
725 ..Nanomotor/nanoactuator
726 ...Using chemical reaction/biological energy (e.g., ATP, etc.)
727 ..Formed from biological material
728 ...Nucleic acids (e.g., DNA or RNA, etc.)
729 ...From protein or unit thereof (e.g., enzyme or carboxyl group, etc.)
730 ...For electrical purposes
731 ..Formed from a single atom, molecule, or cluster
732 ..Nanocantilever
733 ..Nanodiaphragm
734 .Fullerenes (i.e., graphene-based structures, such as nanohorns, nanococoons, nanoscrolls, etc.) or fullerene-like structures (e.g., WS2 or MoS2 chalcogenide nanotubes, planar C3N4, etc.)
735 ..Carbon buckyball (C60, C70, etc., and derivatives and modifications thereof)
736 ...Having atoms interior to the carbon cage
737 ...Having a modified surface
738 ....Modified with biological, organic, or hydrocarbon material
739 .....Modified with an enzyme
740 ....Modified with atoms or molecules bonded to the surface
741 ....Modified with dissimilar atom or molecule substituted for carbon atoms of the buckyball (e.g., impurity doping or compositional substitution, etc.)
742 ..Carbon nanotubes (CNTs)
743 ...Having specified tube end structure (e.g., close-ended shell or open-ended tube, etc.)
744 ...Having atoms interior to the carbon cage
745 ...Having a modified surface
746 ....Modified with biological, organic, or hydrocarbon material
747 .....Modified with an enzyme
748 ....Modified with atoms or molecules bonded to the surface
749 ....Modified with dissimilar atoms or molecules substituted for carbon atoms of the CNT (e.g., impurity doping or compositional substitution, etc.)
750 ...Single-walled
751 ....With specified chirality and/or electrical conductivity (e.g., chirality of (5,4), (5,5), (10,5), etc.)
752 ...Multi-walled
753 ..With polymeric or organic binder
754 .Dendrimer (i.e., serially branching or "tree-like" structure)
755 .Nanosheet or quantum barrier/well (i.e., layer structure having one dimension or thickness of 100 nm or less)
756 ..Lipid layer
757 ...Layer containing protein
758 ..Mono-atomic layer or 8-doped (delta-doped) sheet
759 ..Quantum well dimensioned for intersubband transitions (e.g., for use in unipolar light emitters or quantum well infrared photodetectors, etc.)
760 ..Superlattice with graded effective bandgap (e.g., "CHIRP-graded" superlattice, etc.)
761 ..Superlattice with well or barrier thickness adapted for increasing the reflection, transmission, or filtering of carriers having energies above the bulk-form conduction or valence band energy level of the well or barrier (i.e., well or barrier with ninteger^carrier/4 thickness)
762 .Nanowire or quantum wire (axially elongated structure having two dimensions of 100 nm or less)

NANOSTRUCTURE

.Nanowire or quantum wire (axially elongated structure having two dimensions of 100 nm or less)

763 ..Formed along or from crystallographic terraces or ridges

764 ..With specified packing density

765 ..With specified cross-sectional profile (e.g., belt-shaped, etc.)

766 ..Bent wire (i.e., having nonliner longitudinal axis)

767 ...Mesh structure

768 ...Helical wire

769 ....Formed with nucleic acid

770 ....Formed with polyamide polymers

771 ...Nanoring

772 ....Formed from circular biomolecule (e.g., DNA, heme, chelators, etc.)

773 .Nanoparticle (structure having three dimensions of 100 nm or less)

774 ..Exhibiting three-dimensional carrier confinement (e.g., quantum dots, etc.)

775 ..Nanosized powder or flake (e.g., nanosized catalyst, etc.)

776 ...Ceramic powder or flake

777 ...Metallic powder or flake

778 .Within specified host or matrix material (e.g., nanocomposite films, etc.)

779 ..Possessing nanosized particles, powders, flakes, or clusters other than simple atomic impurity doping

780 ..Possessing fully enclosed nanosized voids or physical holes

781 ..Possessing nonosized surface openings that extend partially into or completely through the host material

782 ..Possessing nanosized physical convexity, ridge, or protrusion extending upward from the host's surface

783 ..Organic host/matrix (e.g., lipid, etc.)

784 ..Electrically conducting, semi-conducting, or semi-insulating host material

785 ..Electrically insulating host material

786 ..Fluidic host/matrix containing nanomaterials

787 ...Viscous fluid host/matrix containing nanomaterials

788 .Of specified organic or carbon-based composition

789 ..In array format

790 ...With heterogeneous nanostructures

791 ....Molecular array

792 .....Nucleic acid array (e.g., human genome array, etc.)

793 .....Protein array

794 ....Chemical library array

795 ..Composed of biological material

796 ...For electrical or electronic purpose

797 ..Lipid particle

798 ...Having internalized material

799 ....Containing biological material

800 .....Nucleic acid (e.g., DNA or RNA, etc.)

801 .....Drug

802 ..Virus-based particle

803 ...Containing biological material in its interior

804 ....Containing nucleic acid

805 ....Containing drug

806 ...With exterior chemical attachment

807 ....Exterior attachment for detection

808 ....Exterior attachment for targeting (e.g., drug targeting, etc.)

809 ..Organic film on silicon

810 .Of specified metal or metal alloy composition

811 .Of specified metal oxide composition (e.g., conducting or semiconducting compositions such as ITO, ZnOx, etc.)

812 ..Perovskites and superconducting composition (e.g., $Ba_xSr_{1-x}TiO_3$, etc.)

813 .Of specified inorganic semiconductor composition (e.g., periodic table group IV-VI compositions, etc.)

814 ..Group IV based elements and compounds (e.g., $C_xSi_yGe_z$, porous silicon, etc.)

815 ..Group III-V based compounds (e.g., $Al_aGa_bIn_cN_xP_yAs_z$, etc.)

816 ...III-N based compounds (e.g., $Al_xGa_yIn_zN$, etc.)

817 ....High-indium-content InGaN pooling or clusters

818 ...III-P based compounds (e.g., $Al_xGa_yIn_zP$, etc.)

819 ...III-As based compounds (e.g., $Al_xGa_yIn_zAs$, etc.)

820 ...III-Sb based compounds (e.g., $Al_xGa_yIn_zSb$, etc.)

821 ...Mixed group V compounds (e.g., $III\text{-}N_xP_y$, etc.)

822 ...Boron-containing compounds

823 ...T1-containing or Bi-containing compounds

824 ..Group II-VI nonoxide compounds (e.g., Cd_xMn_yTe, etc.)

825 ..Heterojunction formed between semiconductor materials that differ in that they belong to different periodic table groups (e.g., Ge (Group IV) - GaAs (Group III-V) or InP (group III-V) - CdTe (Group II-VI), etc.)

826 ..Nonstoichiometric semiconductor compounds (e.g., III_xV_y; $x \neq y$, etc.)

827 .Formed from hybrid organic/inorganic semiconductor compositions

828 ..Biological composition interconnected with inorganic material

829 ..Organic or biological core coated with inorganic shell

NANOSTRUCTURE
.Formed from hybrid organic/inorganic semiconductor compositions
830 ..Inorganic core or cluster coated with organic or biological shell
831 .Of specified ceramic or electrically insulating compositions
832 .Having specified property (e.g., lattice-constant, thermal expansion coefficient, etc.)
833 ..Thermal property of nanomaterial (e.g., thermally conducting/insulating or exhibiting Peltier or Seebeck effect, etc.)
834 ..Optical properties of nanomaterial (e.g., specified transparency, opacity, or index of refraction, etc.)
835 ..Chemical or nuclear reactivity/stability of composition or compound forming nanomaterial
836 ...Having biological reactive capability
837 ..Piezoelectric property of nanomaterial
838 ..Magnetic property of nanomaterial
839 MATHEMATICAL ALGORITHMS, E.G., COMPUTER SOFTWARE, ETC., SPECIFICALLY ADAPTED FOR MODELING CONFIGURATIONS OR PROPERTIES OF NANOSTRUCTURE
840 MANUFACTURE, TREATMENT, OR DETECTION OF NANOSTRUCTURE
841 .Environmental containment or disposal of nanostructure material
842 .For carbon nanotubes or fullerenes
843 ..Gas phase catalytic growth (i.e., chemical vapor deposition)
844 ..Growth by vaporization or dissociation of carbon source using a high-energy heat source (e.g., electric arc, laser, plasma, e-beam, etc.)
845 ..Purification or separation of fullerenes or nanotubes
846 ..Internal modifications (e.g., filling, endohedral modifications, etc.)
847 ..Surface modifications (e.g., functionalization, coating, etc.)
848 ..Tube end modifications (e.g., capping, joining, splicing, etc.)
849 .With scanning probe
850 ..Scanning probe control process
851 ...Particular movement or positioning of scanning tip
852 ..For detection of specific nanostructure sample or nanostructure-related property
853 ...Biological sample
854 ...Semiconductor sample
855 ..For manufacture of nanostructure
856 ...Including etching/cutting
857 ...Including coating
858 ...Including positioning/mounting nanostructure
859 ...Including substrate treatment
860 ..Scanning probe structure
861 ...Scanning tunneling probe
862 ...Near-field probe
863 ...Atomic force probe
864 ...Electrostatic force probe
865 ...Magnetic force probe
866 ...Scanning capacitance probe
867 ...Scanning thermal probe
868 ...With optical means
869 ....Optical microscope
870 ....Optical lever arm for reflecting light
871 ...With environmental regulation means
872 ...Positioner
873 ...Tip holder
874 ...Probe tip array
875 ...With tip detail
876 ....Nanotube tip
877 ....Chemically functionalized
878 ....Shape/taper
879 ....Material
880 .With arrangement, process, or apparatus for testing
881 ..Microscopy or spectroscopy (e.g., SEM, TEM, etc.)
882 .Assembling of separate components (e.g., by attaching, etc.)
883 ..Fluidic self-assembly ("FSA")
884 ..Assembled via biorecognition entity
885 ...Via nucleic acid hybridization
886 ...Via protein recognition
887 .Nanoimprint lithography (i.e., nanostamp)
888 .Shaping or removal of materials (e.g., etching, etc.)
889 ..By laser ablation
890 .Deposition of materials (e.g., coating, CVD, or ALD, etc.)
891 ..Vapor phase deposition
892 ..Liquid phase deposition
893 ..Deposition in pores (molding) with subsequent removal of mold
894 .Having step or means utilizing biological growth
895 .Having step or means utilizing chemical property
896 ..Chemical synthesis (e.g., chemical bonding or breaking, etc.)
897 ...Polymerization
898 ...Enzymatic
899 ...Electrolytic
900 .Having step or means utilizing mechanical or thermal property (e.g., pressure, heat, etc.)
901 .Having step or means utilizing electromagnetic property (e.g., optical, x-ray, electron beamm, etc.)
902 SPECIFIED USE OF NANOSTRUCTURE
903 .For conversion, containment, or destruction of hazardous material
904 .For medical, immunological, body treatment, or diagnosis

SPECIFIED USE OF NANOSTRUCTURE
.For medical, immunological, body treatment, or diagnosis
905 ..Specially adapted for travel through blood circulatory system
906 ..Drug delivery
907 ...Liposome
908 ..Mechanical repair performed/surgical
909 ...Obstruction removal
910 ...Strengthening cell or tissue
911 ...Cancer cell destruction
912 ...Cancer cell repair
913 ...Stem cell therapy implantation
914 ..Protein engineering
915 ..Therapeutic or pharmaceutical composition
916 ...Gene therapy
917 ...Vaccine
918 ..Immunological
919 ..Dental
920 ..Detection of biochemical
921 ...Of toxic chemical
922 ...Of explosive material
923 ..Cell culture
924 ..Using nanostructure as support of DNA analysis
925 ..Bioelectrical
926 ..Topical chemical (e.g., cosmetic or sunscreen, etc.)
927 ..Diagnostic contrast agent
928 ...X-ray agent
929 ...Ultrasound contrast agent
930 ...MRI contrast agent
931 ..Medical device coating
932 .For electronic or optoelectronic application
933 ..Spintronics or quantum computing
934 ...Giant magnetoresistance (GMR)
935 ...Spin dependent tunnel (SDT) junction (e.g., tunneling magnetoresistance (TMR), etc.)
936 ..In a transistor or 3-terminal device
937 ...Single electron transistor
938 ...Field Effect transistors (FETs) with nanowire- or nanotube-channel region
939 ...Electron emitter (e.g., Spindt emitter tip coated with nanoparticles, etc.)
940 ..In a logic circuit
941 ...Including DNA logic element
942 ...Including Protein logic element
943 ..Information storage or retrieval using nanostructure
944 ...Biochemical memory
945 ....Protein memory
946 ....Nucleic acid memory
947 ...With scanning probe instrument
948 ..Energy storage/generating using nanostructure (e.g., fuel cell, battery, etc.)
949 ..Radiation emitter using nanostructure
950 ...Electromagnetic energy
951 ....Laser
952 ..Display
953 ..Detector using nanostructure
954 ...Of radiant energy
955 ...Of thermal property
956 ...Of mechanical property
957 ...Of chemical property or presence
958 ....Of biomolecule property
959 .....Of disease state
960 ...Of magnetic property
961 .For textile or fabric treatment
962 .For carrying or transporting
963 MISCELLANEOUS

C. CHANGES TO THE U.S. – I. P. C. CONCORDANCE

U. S.		I. P. C.	
Class	Subclass	Subclass	Notation
977	700-838	B82B	1/00
977	839-901	B82B	3/00
977	902-962	B82B	1/00
977	963	B82B	1/00
977	963	B82B	3/00

CLASS 977 - NANOTECHNOLOGY

Digest Abolished:

Digest 1

Definitions Established:

SECTION I - CLASS DEFINITION

CROSS-REFERENCE ART COLLECTIONS

This Nanotechnology art collection provides for disclosures related to:

i. Nanostructure and chemical compositions of nanostructure;

ii. Device that include at least one nanostructure;

iii. Mathematical algorithms, e.g., computer software, etc., specifically adapted for modeling configurations or properties of nanostructure;

iv. Methods or apparatus for making, detecting, analyzing, or treating nanostructure; and

v. Specified particular uses of nanostructure.

As used above, the term "nanostructure" is defined to mean an atomic, molecular, or macromolecular structure that:

(a) Has at least one physical dimension of approximately 1-100 nanometers; and

(b) Possesses a special property, provides a special function, or produces a special effect that is uniquely attributable to the structure's nanoscale physical size.

(1) Note. It should be noted that this is a cross-reference collection of art only and will not, therefore, take for original placement any U.S. Patent.

(2) Note. Class 977 generally does not cover chemical or biological structures, *per se*, specifically provided for elsewhere. That is, a compound, element, or composition of matter of nanoscale dimension is not considered to be sufficient by itself for placement in Class 977. Compounds, elements, composites, and compositions of matter of nanoscale dimension are placed in the U.S. Patent Classification system (USPC) where such compounds, elements, composites, and compositions of matter are classifiable unless they have particularly shaped configurations (e.g., fullerenes or fullerene-like structures, etc.) formed during manufacture which impart special properties or functions to the nanostructural assemblage related to the altering of basic chemical or physical properties attributed to the nanoscale.

(3) Note. Special properties and functionalities should be interpreted broadly, and are defined as those properties and functionalities that are significant,

distinctive, non-nominal, noteworthy, or unique as a result of the nanoscale dimension. In general, differences in properties and functionalities that constitute mere differences of scale are insufficient to warrant inclusion of the subject matter in Class 977. The following non-limiting examples illustrate the distinction between mere scaling of size attributes vs. special attributes unique to nanoscale dimensions:

(a) A conductor of nanoscale width that exhibits substantially the same electrical properties (albeit scaled down) as when the same conductor has a substantially larger width (and has no other special properties) would not be classifiable in Class 977. However, a conventional conductor that exhibits quantum confinement or superconductivity only when formed so as to have a nanoscale width would be classifiable in Class 977.

(b) Nanosized catalyst and solid sorbent particles or catalyst and solid sorbents having nanosized pores are only classified in this class if it is shown that they achieve a unique property as a result of the nanoscale dimension. This does not include the benefits of having a higher specific surface area or a higher porosity, which naturally follow from a reduction in particle size or pore size.

(4) Note. The subject matter to be found here is limited to the stated range of nanoscale dimension solely for *physical* dimension. This includes physical dimensions that may be less than 1 nanometer (e.g., on the order of Angstroms) or slightly larger than 100 nanometers. Non-physical nanoscale dimensions are excluded from the scope of Class 977. The following are non-limiting examples of subject matter having non-physical nanoscale dimensions that are generally excluded from Class 977:

(a) Electromagnetic radiation with wavelengths on the order of 1–100 nanometers (i.e., extreme UV to soft X-ray wavelengths), as well as related materials, devices and methods for producing or for detecting wavelengths within this range;

(b) Nanoscale effects or phenomena pertaining solely to electrical fields, electric potentials or charge carriers when the underlying physical structures that produce these phenomena or effects do not, themselves, have nanoscale dimensions: e.g., charge depletion regions, carrier energy-band bending effects, or 2-dimensional carrier gases that exist within a region of less than a 100 nm width, but that are produced at the junction of two layers, which in turn, each have physical thicknesses substantially greater than 100 nm.

(5) Note. Apparatus for manufacturing nanostructures, nanomaterials and nanodevices under the scope of Class 977 is generally limited to apparatus specifically adapted for creating ordered structures on a nanometer scale, i.e. apparatus for “bottom up” manufacturing to create larger structures from atomic and molecular constituents. Apparatus for “top down” bulk manufacturing of nanostructures, nanomaterials and nanodevices are generally excluded from this Class.

(6) Note. The subject matter to be found here is generally limited to subject matter that is not specifically provided for elsewhere within the primary classification areas of the U.S. Patent Classification System even if this subject matter may otherwise satisfy the stated definition of nanotechnology. The following are non-limiting examples of subject matter that is generally excluded from coverage by Class 977 for the following reasons:

(a) Quantum well, quantum barrier, and superlattice structures not specifically provided for in this Class, and which are more specifically provided for in Class 257 Active Solid-State Devices (see Section II below, Class 257);

(b) Molecular sieves and nanosized pores in catalysts, solid sorbents, and supports therefor (See Section II, below, Class 502);

(c) Colloids and solid sorbents, as well as processes of making (See Section II, below, Class 516);

(d) Devices possessing non-quantum-well or non-quantum-barrier nanosheets (e.g., double-heterojunction p-i-n LEDs or p-i-n photodetectors having a non-quantum well active layer with a thickness within the range of 1–100 nm, etc.) or associated methods of making that are not specifically provided for in the present cross-reference class, and which are more specifically provided for elsewhere in Class 257 Active Solid-State Devices (e.g., Transistors, Solid-State Diodes) subclasses 79+ for incoherent light emitter structures, or subclasses 428+ responsive to electromagnetic or particle radiation or light; or elsewhere in Class 438 Semiconductor Device Manufacturing Process, subclasses 22+ for making device or circuit emissive of nonelectrical signal or subclasses 57+ for making device or circuit responsive to electromagnetic radiation;

(e) Devices possessing nanosheet buffer layers that are not specifically provided for in the present cross-reference class, and which are more specifically provided for elsewhere in Class 257--Active Solid-State Devices (e.g., Transistors, Solid-State Diodes) subclass 190 heterojunction device with lattice constant mismatch (e.g., with buffer layer to accommodate mismatch, etc.);

(f) Nanosheets that function as refractive, reflective, antireflective or light-shielding coatings or layers (e.g., optical waveguides and Distributed Bragg Reflectors, etc.) or associated methods of making that are not specifically provided for in the present cross-reference class, and which are more specifically provided for elsewhere in Class 257-- Active Solid-State Devices (e.g., Transistors, Solid-State Diodes); Class 385--Optical Waveguides; Class 372--Coherent Light Generators; or Class 438--Semiconductor Device Manufacturing: Process subclasses;

(g) Nanosheets in heterojunction devices serving functions besides, or in addition to, buffering lattice mismatches or enhancing optical properties that are not specifically provided for in the present cross-reference class, and which are more specifically provided for elsewhere

in Class 257--Active Solid-State Devices (e.g., Transistors, Solid-State Diodes), subclasses 183+ for heterojunction devices (e.g., HEMTs and MESFETs, etc., having a nanosheet channel layer regardless of whether a two-dimensional carrier gas is produced);

(h) Devices possessing tunneling junctions that are not specifically provided for in Class 977, and which are more specifically provided for elsewhere in Class 257 Active Solid-State Devices (e.g., Transistors, Solid-State Diodes) subclasses 104+ for tunneling pn junction (e.g., Esaki diode, etc.) devices;

(i) Electron field emitters (e.g., pointed "Spindt emitters," etc., wherein the emitter tips' radius of curvature is less than 100 nm) or associated methods of making that are not specifically provided for in Class 977, and which are more specifically provided for elsewhere in Class 257 Active Solid-State Devices (e.g., Transistors, Solid-State Diodes) subclasses 10+ for low workfunction layer for electron emission (e.g., photocathode electron emissive layer, etc.).

(j) Cells of organisms, such as prokaryotic or eukaryotic cells or organelles thereof which are utilized generally for a function, which is naturally occurring, are provided for elsewhere in Class 435.

(k) Enzyme or protein complexes, such as multisubunit enzymes, which are generally utilized for their normal or natural enzymatic function are provided for elsewhere in Classes 435 and 530.

(l) Viruses are generally provided for in Classes 424 and 435, wherein the viruses or parts thereof have been modified so as to utilize a function which is naturally or normally occurring as a virus function. Such modification includes enhancement of natural function, for example, to make a virus more virulent and also includes viral modification to carry a genetic element or gene which is not present in naturally occurring viruses. Bacterial viruses are generally termed bacteriophages. A virus, however, that is utilized for a non-viral type of function, such as being a building block for a Nanostructure would be included in Class 977.

(m) Protein engineering is provided for elsewhere in Class 530 such as directed to synthesis of enhanced function protein via a new amino acid sequence, for example, to induce a newly folded form with greater biological activity. If the protein engineering, however, adds a function to the protein which was not previously present such as a Nanostructured protein to possess a special property, provide a special function, or produce a special effect; it is then considered for classification in Class 977. An example of protein engineering that reasonably is a Nanotechnology type of invention is modifying a protein so that it is usable as a switching element in an otherwise electronic circuit.

SECTION II - REFERENCES TO OTHER CLASSES

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclass 105 for atomic force microscope which scans a tip across the surface of a sample and monitors the deflection of the tip caused by atomic forces between the atoms in the tip and the atoms in the sample.

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, appropriate subclasses based on metal powder composition; subclasses 255-254 for compositions which comprise loose particles or a metal or alloy mixed with loose particles of a different metal or alloy or with loose particles of a nonmetal; subclasses 331-341 for processes of producing metal or alloy particulates directly from liquid metal; and subclasses 343-374 for processes of producing metal or alloy powder, i.e., under 1,000 microns in its largest dimension.

117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, particularly subclasses 4-10 for processes of crystal growth from solid or gel state, and subclasses 84-109 for processes of crystal growth from vapor state wherein the growth occurs by atomic layer deposition, e.g., atomic layer epitaxy, etc.

118, Coating Apparatus, subclasses 715-733 for gas or vapor deposition apparatus, and particularly subclass 723 for ion cluster beam deposition apparatus.

128, Surgery, all subclasses for miscellaneous methods and respiratory devices and methods.

148, Metal Treatment, subclasses 33-33.6 for barrier layer stock material, including electrically semiconductive superlattices formed via atomic layer deposition, e.g., atomic layer epitaxy, etc.; subclasses 95-714 for processes of modifying or maintaining the internal physical structure, i.e., microstructure, of metal or metal alloys such as by the creation of nanosized precipitates via age hardening, etc.; and subclasses 400-442 for products of a Class 148 process.

201, Distillation: Processes, Thermolytic, appropriate subclasses for thermolytic distillation processes limited to the heating of a solid carbonaceous material (distilland) to vaporize the portion volatile under the conditions employed and to cause a compound or compounds in the material to undergo chemical decomposition (thermolysis) to form different chemical substances, at least some of which are volatile under the condition employed and an unvaporized solid carbonaceous material.

250, Radiant Energy, subclass 216 for near-field scanning optical microscope wherein light is directed through an aperture having a diameter less than the wavelength of the light and the aperture is located adjacent to a surface to be observed and scanned across the surface, and subclasses 306 and 307 for scanning tunneling microscopes and methods of using them, respectively, wherein a potential voltage is applied across a conductive sample and a conductive tip is scanned across the sample without actually contacting the sample and the current of the electrons tunneling across the gap between the sample and the tip is monitored.

257, Active Solid-State Devices (e.g., Transistors, Solid-State Diodes) subclasses 9-39 for thin active physical layer which is (1) an active potential well layer thin enough to establish discrete quantum energy levels or (2) an active barrier layer thin enough to permit quantum mechanical tunneling or (3) an active layer thin enough to permit carrier transmission with substantially no scattering, e.g., superlattice quantum well or ballistic transport device, etc.; subclasses 10 and 11 for low workfunction layer for electron emission, e.g., photocathode electron emissive layer, etc.; subclasses 40, 42, 43, 76-78, and 613-616 for semiconductors possessing specified organic or inorganic material compositions; subclasses 79-103 for incoherent light emitter structures and associated optical elements; subclasses 104-106 for tunneling pn junction, e.g., Esaki diode, etc., devices; subclasses 183-201 for heterojunction devices including subclass 190 heterojunction device with lattice constant mismatch, e.g., with buffer layer to accommodate mismatch, etc.;

subclass 194 for high electron mobility transistors (HEMTs); and subclasses 428-466 for devices responsive to electromagnetic or particle radiation or light and associated optical elements.

310, Electrical Generator or Motor Structure, subclass 311 for piezoelectric elements and devices of the type used to move scanning probe microscopes with nanometric resolution.

313, Electric Lamp and Discharge Devices, subclasses 346 and 373-383 for photoemissive cathodes; and subclasses 527, 530, 541, and 542-544 for photocathodes in general.

324, Electricity: Measuring and Testing, subclasses 244 and 260 for a scanning magnetic force microscopes; subclasses 300-322 for scanning electron paramagnetic resonance microscopes for using magnetic resonance with a scanning probe to detect atomic structure in a sample surface; and subclasses 658-690 for scanning capacitance microscopes.

351, Optics: Eye Examining, Vision Testing and Correcting, subclasses 200-247 for eye examining or testing instruments.

372, Coherent Light Generators, subclasses 43.01-50.23 for semiconductor devices having (1) quantum wells and/or barriers for producing coherent light; and (2) waveguides, Distributed Bragg Reflector, and other optical elements.

374, Thermal Measuring and Testing, subclasses 6, 43, 45, and 120-135 for scanning thermal microscopes.

385, Optical Waveguides, appropriate subclasses for nanosheets that function as refractive, reflective, antireflective or light-shielding coatings or layers, e.g., optical waveguides and Distributed Bragg Reflectors, etc.

420, Alloys or Metallic Composition, appropriate subclasses, particularly those subclasses based on alloy compositions.

423, Chemistry of Inorganic Compounds, subclass 445 for fullerenes in essentially pure form.

428, Stock Material or Miscellaneous Articles, appropriate subclasses, particularly subclass 408 for self-sustaining carbon mass, e.g. bulk structure or layer comprising fullerene or fullerene-like structures, etc.; subclasses 411.1-704 for non-structural laminates and subclasses 323-331 layer containing structurally defined particles; subclass 446 and subclass 451 for laminates comprising a layer of silicon and a layer of silicon next to addition polymers; subclasses 544-687 for structures of all metal or with adjacent metals; subclasses 688-703 for non-structural laminates of inorganic materials and subclass 620 for all metal composite where one of the layers is a semiconductor layer; and subclasses 689-703 for non-structural laminates of inorganic metal compound containing layer, e.g. ceramics, etc.

438, Semiconductor Device Manufacturing: Process, subclasses 22-47 for making devices or circuits emissive of nonelectrical signal, subclasses 29, 65, and 69-72 for making light emitters and detectors with optical elements; and subclasses 57-98 for making devices or circuits responsive to electromagnetic radiation.

501, Compositions: Ceramic, appropriate subclasses, particularly subclasses based on composition of ceramic powder.

502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, appropriate subclasses for catalyst or solid sorbents and methods of manufacture wherein nanoscale porosity is not disclosed as imparting significant, distinctive, non-nominal, noteworthy, or unique catalytic or sorbent properties other than derived from the mere difference in surface area associated with nanoscale porosity.

514, Drug, Bio-Affecting and Body Treating Compositions, appropriate subclasses, particularly subclasses 937-945 for radionuclide-containing colloidal particulate, e.g., microcapsule, micro-sphere, micro-aggregate, etc., compositions.

516, Colloid Systems and Wetting Agents; Subcombinations Thereof; Processes of Making, Stabilizing, Breaking, or Inhibiting, subclasses 9-97 for continuous liquid phase colloid systems,

also called colloid dispersions or colloid suspensions, including aerosols, smokes, fogs, liquid foams, emulsions, sols, gels, coagulates, or pastes; subclasses 98-112 for colloid systems of continuous or semicontinuous liquid phase; subclasses 198-204 for wetting agents, etc., having nanosized dispersed phase.

600, Surgery, appropriate subclasses, particularly subclasses 300-595 for measuring or detecting constituent of body liquid; subclasses 407-480 for detecting nuclear, electromagnetic, or ultrasonic radiation, subclasses 481-528 for cardiovascular; subclasses 529-543 for respiratory; and subclasses 544 and 545 for measuring electrical characteristic of body portion.

601, Surgery: Kinesitherapy, appropriate subclasses for kinesitherapy.

602, Surgery: Splints, Braces or Bandages, appropriate subclasses for splints, braces or bandages.

604, Surgery, subclasses 1-540 for means of introducing/ removing substances to/from the body for therapy; and subclasses 890.1-892.1 for implanted pump.

606, Surgery, appropriate subclasses for surgical instruments.

607, Surgery: Light, Thermal, and Electrical Application, appropriate subclasses for light, thermal, and electrical application for therapy.

623, Prosthesis (i.e., Artificial Body Members), Parts Thereof, or Aids and Accessories Therefor, appropriate subclasses for prosthetics, i.e., artificial body members, parts, and aids and accessories.

SECTION III - GLOSSARY:

2DEG (Two-Dimensional Electron Gas)

State of electrons in quantum well.

ARRAY

Arrangement of multiple units, usually ordered; array may be organized in linear, flat, or 3-dimensional positioning of the multiple units.

ARTIFICIAL ATOM

Quantum dot that confines a certain number or electrons producing an electron waveform structure quantum, which is mechanically analogous to an atom; alternatively used to describe hollow spherical fullerene, such as buckyballs filled with a dopant, etc.

ATOMIC FORCE MICROSCOPE (AFM)

Instrument with a nanosized tip that manipulates or detects based upon a separation dependency force between the tip and the object being manipulated or detected.

BIOMIMETICS or BIOMIMICRY

Nanotechnology designed to mimic biological structure/processes.

BIONANOTECHNOLOGY (NANOBIOTECHNOLOGY)

Branch of nanotechnology that uses biological structures, such as proteins, ATPs, DNA, etc., as building blocks of nanoscale devices. Sometimes called “wet-dry” technology, wherein the term “wet” pertains to biological components and “dry” refers to engineered, inorganic nanoparticles.

BOSE-EINSTEIN CONDENSATE

State of matter occurring in certain materials at low temperature wherein particles behaving under Fermi-Dirac statistics, such as electrons, etc., behave like particles under Bose-Einstein statistics, such as photons, etc.; also occurs in superconducting materials.

BOSE-EINSTEIN STATISTICS

Statistical distribution of boson particles, such as photons (light particles), etc., occurring between energy states.

BOTTOM-UP MANUFACTURING

Manufacturing that starts with atomic or molecular particles and builds up; term is often contrasted with top-down manufacturing employing etching, deposition, evaporation, etc., associated with traditional semiconductor processes in which processing involves bulk addition or removal steps.

BROWNIAN MOTION

Stochastic motion of a particle suspended in a surrounding gas or liquid comprised of other particles, molecules, or atoms, which is in thermodynamic equilibrium.

BUCKMINSTERFULLERENE or BUCKYBALL

Soccer-ball-shaped form of fullerene (C_{60}).

CHEMICAL FORCE MICROSCOPE

Scanning probe microscope with a chemically functionalized tip.

CARBOHYDRATE

Polyhydroxy aldehydes or ketones which frequently have the empirical formula $(CH_2O)_n$ and their derivatives, frequently termed saccharides; common forms are monosaccharides, oligosaccharides, and polysaccharides.

COLLOID

Suspension of finely divided particles in a continuous medium, which may be gaseous, liquid, or solid.

DE BROGLIE WAVELENGTH

Wavelength of a particle under quantum mechanical conditions wherein the particle acts as a wave; calculated by a ratio of Planck's constant to the particle's momentum.

DENDRIMER

Artificially manufactured molecule, such as a synthesized polymer, etc.

DENSITY FUNCTIONAL THEORY (DFT)

Theory explaining and calculating the electronic structure of molecules and solids.

DIP PEN NANOLITHOGRAPHY

Method of fabrication utilizing a scanning probe tip to draw nanostructures on surfaces.

ENZYME

Protein that functions as a biochemical catalyst for a biochemical reaction.

FERMI-DIRAC STATISTICS

Statistical distribution of fermionic particles, such as electrons between energy states, etc.

FULLERENE

Any of various cage-like, hollow molecules composed of hexagonal and pentagonal groups of atoms, and especially those formed from carbon, that constitute the third form of carbon after diamond and graphite; alternatively, a class of cage-like carbon compounds composed of fused, pentagonal, or hexagonal sp^2 carbon rings.

FULLERIDE

Fullerene doped with alkali metal.

GRAETZEL CELL

Photovoltaic cell that uses nanoscale titanium dioxide and organic dye to obtain electrical current from incident light.

GRAPHENE

Two-dimensional sheet form of fullerene.

GENE THERAPY

Treatment of a disease or disorder via insertion of a foreign gene into a cell or cells in order to change the genetic content thereof.

LANGMUIR-BLODGETT FILM

Film of surfactant molecules on a liquid surface forming regular stacks (a multilayer) or can be only one molecule thick (a monolayer); may also be formed on solid surfaces.

LIPID

Water-insoluble organic substances naturally found in cells that are extractable by nonpolar solvents such as chloroform, ether, or benzene. Lipids generally serve four general functions: (1) as structural components of membranes; (2) as intracellular storage depots of metabolic fuel; (3) as a transport form of metabolic fuel; and (4) as protective components of cell walls of many organisms. Some examples of natural lipids are long-chain fatty acids, fatty acid esters, acylglycerols, phosphoglycerides, steroids, waxes, terpenes, and fat-soluble vitamins.

LIPOSOME

Particle with a lipid-containing outer wall that has an interior space that may contain various molecule types.

MAGNETIC FORCE MICROSCOPE

Scanning probe microscope in which a magnetic force causes the tip to move.

MAXWELL-BOLTZMANN STATISTICS

Statistical distribution of classical (nonquantum) particles, such as molecules in a gas, etc., between energy states.

MEMS (MICROELECTROMECHANICAL SYSTEMS)

Systems including components from 1-100 microns in size with a movable member and an electrical input and/or output to the movable member; refers to scanning probes and other devices interfacing with the nanoscale; differentiated from nanotechnology not just in size but also via top-down versus bottom-up manufacturing approach.

MOIETY

Component part of a complex molecule.

MOLECULAR ASSEMBLER or NANOASSEMBLER or ASSEMBLER

Theoretical conception of a molecular machine capable of building other molecular structures.

MOLECULAR ELECTRONICS or MOLETRONICS

Electronic devices based on components consisting of individual molecules.

MOLECULAR NANOTECHNOLOGY

Broadly refers to nanotechnology involving molecules. (Drexlerian) Sometimes used to distinguish nanotechnology employing theoretical molecular assemblers from other forms of nanotechnology.

MWNT (MULTI-WALLED NANOTUBE)

Formed of multiple layers of graphene wrapped in cylindrical form.

NANOCLUSTER

Cluster of atoms or molecules whose characteristic dimensions are a few nanometers; sometimes synonymous with nanocrystal or denoting structures smaller than nanocrystals.

NANOCOMPOSITE

Composite structure whose characteristic dimensions are found at the nanoscale.

NANOCRYSTAL

Nanoscopic particle containing a few hundred to a few tens of thousands of atoms, and arranged in an orderly, crystalline structure; often refers to metallic nanoparticles.

NANOPORE

Pore of nanometer dimensions.

NANOROD

Nanostructures shaped like long sticks or dowels with a diameter in the nanoscale but having a length that is very much longer.

NANOTUBE

Fullerene molecule having a cylindrical or toroidal shape.

NANOTWEEZERS

Element used to pick up and place individual nanosized particles, usually including two opposing nanosized elements, such as nanotubes, etc., that pick and place the nanosized particles.

NANOWIRE

Electrically conductive nanorod; alternatively, a wire with a diameter of nanometer dimensions.

NANOWHISKER

Often synonymous with nanorod, nanowire, or nanotube.

NEAR FIELD SCANNING OPTICAL MICROSCOPE

Scanning probe microscope that analyzes an object by recording light intensity focused through a pipette in the tip and scanned across the object at a distance less than a wavelength of the light.

NUCLEIC ACID

Compounds containing three components: (1) a nitrogenous base; (2) a five-carbon sugar; and (3) phosphoric acid; forms include mononucleotides, oligonucleotides and polynucleotides. The most common forms are DNA (deoxyribonucleic acid) and RNA (ribonucleic acid), which predominantly occur in nature in polynucleotide form that are polymers of mononucleotides.

POLYMER

Extended molecule made by bonding together subunits called monomers; examples include polystyrene, polyethylene, and protein (natural polymer of amino acids).

PROTEIN FOLDING

Process by which a protein assumes its functional shape; protein folding problem involves the prediction of the protein three-dimensional shape based on its amino acid sequence.

PROTEIN or PEPTIDE

Polymer of amino acid monomeric units linked via peptide bonds; peptide is a short polymer of amino acid units, commonly less than 100 such monomers therein.

QUANTUM CELL

Structure comprising four quantum dots arranged in a square, with two diagonally opposed dots containing electron charges. One diagonal containing charges is arbitrarily defined as representing a value of “1”, the other as “0”; in a five-dot cell, the fifth, central dot contains no charge.

QUANTUM CELL WIRE

Wire in which information is transferred by a change in orientation of quantum cells arranged in a line as opposed to utilizing electron flow.

QUANTUM COMPUTING

Computing scheme dependent upon wavelike properties of elementary particles.

QUANTUM DOT

Broadly, a structure that promotes confinement of electron(s)/hole(s) in three dimensions; alternatively, a location capable of containing a single electron charge; synonymous with single electron transistor, qubit, and quantum bit.

QUANTUM ENTANGLEMENT

The process of combining two separate pieces of information so that they can be treated as a single entity; a correlation between quantum states, e.g., spin, polarization, etc., of two or more particles.

QUANTUM TUNNELING

Effect of transferring of particles through a potential barrier larger than the particles total energy that occurs based upon the barrier thickness and the difference between the potential barrier energy and the particle energy.

QUANTUM UNCERTAINTY PRINCIPLE

Principle stating that the position of a particle and its momentum, or alternatively, energy of the particle and time of measurement; cannot be simultaneously measured with arbitrary precision; noted to not be a significant factor at length scales above the level of an atom.

QUANTUM WELL

Broadly, a structure that promotes electron or hole confinement in one dimension so that the electron or hole can only propagate with two degrees of freedom; with respect to semiconductor physics, a semiconductor heterostructure utilizing a narrow bandgap semiconductor sandwiched between two layers of a larger bandgap semiconductor; alternatively, a potential well that confines particles within a planar region wherein the width of the region is on the order of the De Broglie wavelength of the particles.

QUANTUM WIRE

Structure that promotes electron or hole confinement in two dimensions so that the electron or hole can only propagate with one degree of freedom.

SAM (SELF-ASSEMBLED MONOLAYER)

Molecule-thick, self-assembled film formed at an interface, e.g., gas/liquid, gas/solid, etc.

SCANNING PROBE MICROSCOPE

Generic term for Scanning Tunneling Microscope (STM) and Atomic Force Microscope (AFM) in their many forms.

SCANNING TUNNELING MICROSCOPE (STM)

Instrument with a nanosized tip that manipulates or detects operation based on a quantum tunneling effect generating a current between the tip and an object being manipulated or detected based upon the size of the gap between the tip and object.

SELF-ASSEMBLY

Method of assembling molecules utilizing thermodynamic tendency to seek the lowest energy state for a group of molecules.

SWNT (SINGLE-WALLED NANOTUBE)

Formed from one layer of graphene wrapped in cylindrical form.

VACCINE

Suspension of attenuated or killed microorganisms or viruses that are incapable of inducing severe infection but are capable of producing immune memory when inoculated into a complex organism.

VIRUS

Submicroscopic organism, which may be pathogenic, composed essentially of a core of nucleic acid enclosed by a protein coat, able to replicate only within a living cell.

Cross Reference Art Collections

700 NANOSTRUCTURE:
Subject matter under the class definition directed to the structural features, properties, or characteristics of at least one nanosized element, component, or device.

701 Integrated with dissimilar structures on a common substrate:
Subject matter under subclass 700 wherein a nanostructure is integrated onto a common substrate with one or more different structures, devices, or systems that, in turn, may or may not constitute or include a nanostructure.

(1) Note. Classification under this subclass sequence is appropriate when dissimilar structures, including at least one nanostructure, are integrated on a common

substrate, regardless of whether any one of the dissimilar structures, itself, has uniqueness independent of the integration.

702 Having biological material component:
Subject matter under subclass 701 wherein the dissimilar structures constitute a component that is derived from or relating to a living organism.

703 Cellular:
Subject matter under subclass 702 wherein the biological material component is a cell or a subpart of a cell.

704 Nucleic acids (e.g., DNA or RNA, etc.):
Subject matter under subclass 702 wherein the biological material component is a nucleic acid.

(1) Note. Nucleic acid, such as DNA or RNA, is any of various acids composed of a sugar or derivative of a sugar, phosphoric acid, and a base.

705 Protein or peptide:
Subject matter under subclass 702 wherein the biological material component is a protein or a peptide.

(1) Note. Protein is any of numerous naturally occurring complex combinations of amino acids that contain the elements carbon, hydrogen, nitrogen, oxygen, and other elements.

(2) Note. Peptide is a derivative of two or more amino acids by combination of the amino group of one acid with the carboxyl group of another acid and is usually obtained by partial hydrolysis of proteins.

706 Carbohydrate:
Subject matter under subclass 702 wherein the biological material component is a carbohydrate.

(1) Note. Carbohydrate is any of various neutral compounds of carbon, hydrogen, and oxygen, such as sugars, starches, and celluloses, etc., most of which are formed by green plants.

707 Having different types of nanoscale structures or devices on a common substrate:
Subject matter under subclass 701 wherein two or more different kinds of nanosized structures or devices are integrated on the common substrate.

(1) Note. A specific example of the subject matter included in this subclass is substrate supporting one or more semiconductor nanodots and one or more metal nanodots, but would NOT be proper for a substrate supporting only an array of identical nanodots.

708 With distinct switching device:
Subject matter under subclass 701 including a separate switching device.

(1) Note. The switching devices may or may not constitute or include nanostructures, e.g., a quantum-dot memory array and peripheral, carbon-nanotube-based circuitry interconnected by a separate array of conventional selected transistors, etc.

709 Including molecular switching device:
Subject matter under subclass 708 wherein the nanosized switching device constitutes a molecular structure that exhibits switching properties or capability, e.g., to shift from one to another state, function, etc.

710 Biological switching:
Subject matter under subclass 709 wherein the switching device constitutes a molecular structure of a living organism, e.g., a receptor/ligand switching pair, etc.

711 Nucleic acid switching:
Subject matter under subclass 710 wherein the switching device constitutes molecular structure of a nucleic acid.

712 Formed from plural layers of nanosized material (e.g. stacked structures, etc.):
Subject matter under subclass 701 wherein identical or different nanostructures are provided in two or more layers on a common substrate such as plural layers, each containing vertical nanowires (or "nanovias") for interconnecting three or more interconnected layers; or (2) quantum-dot memory device formed on one layer and nanovias formed on one or more other layers.

713 Including lipid layer:
Subject matter under subclass 712 including one or more nanosized layers that are lipids, e.g., a layered microchip with a lipid nanolayer for attaching component(s) thereon, etc.

714 Containing protein:
Subject matter under subclass 713 wherein the lipid layer contain one or more protein molecules, e.g., protein spanning a lipid layer structure, etc.

715 On an organic substrate:
Subject matter under subclass 701 wherein the common substrate consists of a material relating to or containing carbon compounds, i.e. made of organic material.

716 Biological cell surface:
Subject matter under subclass 715 wherein the organic substrate is the surface of a living cell organism.

717 Lipid substrate:
Subject matter under subclass 715 wherein the organic substrate is a lipid layer, e.g., lipid monolayer or bilayer, etc.

718 Carbohydrate substrate:
Subject matter under subclass 715 wherein the substrate is a carbohydrate layer, e.g., cellulosic paper, etc.

719 Nucleic acid substrate:
Subject matter under subclass 715 wherein the substrate constitutes a nucleic acid, e.g., substrate made of chromosomal network material, etc.

720 **On an electrically conducting, semi-conducting, or semi-insulating substrate:**
Subject matter under subclass 701 wherein the common substrate has an ability to transmit or conduct electrical current; i.e., an electrically conducting, semi-conducting, or semi-insulating substrate.

(1) Note. "Semi-insulating structures" were included in this subsection (as opposed to being included in the insulating substrate subsection) so that distinctions would not have to be drawn between a semiconductor substrate that is doped with shallow impurities, i.e., n- or p-doped, undoped, or doped with deep-level impurities, e.g., Fe or Au, etc.

721 **On a silicon substrate:**
Subject matter under subclass 720 wherein the common substrate is composed of silicon.

(1) Note. This subclass includes Si substrate that may be doped with shallow-level dopants, e.g., p-doped with Al or Ga impurities or n-doped with P or As impurities, etc.; doped with deep-level dopants, e.g., Au or Pt, etc.; or undoped.

722 **On a metal substrate:**
Subject matter under subclass 720 wherein the common substrate is composed of a metal or metal alloy.

723 **On an electrically insulating substrate:**
Subject matter under subclass 701 wherein the common substrate conducts or transmits electrical current.

724 **Devices having flexible or movable element:**
Subject matter under subclass 700 wherein the device includes at least one nanosized flexible member, e.g., a cantilever or diaphragm, etc.; or the device includes a first member that moves, slides, or rotates relative to a second member, in which the first member, second member, or means to interconnect the first and second members are composed of a nanosized structure.

725 **Nanomotor/nanoactuator:**
Subject matter under subclass 724 wherein the nanosized flexible or movable element of a device receives a form of energy to produce motion or to convert a form of energy into mechanical energy.

726 **Using chemical reaction/biological energy (e.g., ATP, etc.)**
Subject matter under subclass 725 wherein the received energy is produced by a chemical reaction or derived from a living organism.

727 **Formed from biological material:**
Subject matter under subclass 724 wherein the nanosized flexible or movable element or structure is composed of or includes a material relating to life or a living organism.

728 **Nucleic acid (e.g., DNA or RNA, etc.):**
Subject matter under subclass 727 wherein the biological material is a nucleic acid, e.g., DNA, etc.

(1) Note. Nucleic acid, such as DNA or RNA, etc., is any of various acids composed of a sugar or derivative of a sugar, phosphoric acid, and a base.

729 From protein or unit thereof (e.g., enzyme or carboxyl group, etc.):
Subject matter under subclass 727 wherein the biological material is specifically derived from a protein or a unit thereof.

(1) Note. Protein is any of numerous naturally occurring complex combinations of amino acids that contain the elements carbon, hydrogen, nitrogen, oxygen, and other elements.

730 For electrical purposes:
Subject matter under subclass 727 wherein the nanosized flexible or movable biological material is specifically employed for electrical or electronic purpose, e.g., used in an electrical device, etc.

731 Formed from a single atom, molecule, or cluster:
Subject matter under subclass 724 wherein the nanosized flexible or movable element or structure constitutes a single atom, molecule, or a group of same elements, e.g., a single atom, molecule, or a group of same elements that is capable of moving around within a hollow cavity of a molecular chamber.

732 Nanocantilever:
Subject matter under subclass 724 including a nanosized structural member with a first end fixed to a support and a second end free to move relative to the support.

733 Nanodiaphragm:
Subject matter under subclass 724 including a nanosized plate, disk, or sheet that bends or vibrates in response to pressure or sound waves.

(1) Note. This subclass does not cover the alternative definition of diaphragm commonly used in the field of optics wherein the term refers to a ring or plate with a hole in the center which is placed on the axis of an optical instrument, such as a camera, and which controls the amount of light entering the instrument.

SEE OR SEARCH THIS CLASS, SUBCLASS:

781, for structures including nanosized physical via-holes or pores.

734 Fullerenes (i.e., graphene-based structures, such as nanohorns, nanococoons, nanoscrolls, etc.) or fullerene-like structures (e.g., WS_2 or MoS_2 chalcogenide nanotubes, planar C_3N_4, etc.):
Subject matter under subclass 700 wherein the nanostructure is formed of caged, curved, or planar graphene or wherein the nanostructure is formed or caged, curved or planar graphene, or hexagon ring structure which constitutes either a non-carbon-based composition, e.g., WS_2 or MoS_2, etc., or substantially a non-carbon-based, e.g., planar C_3N_4, etc.

(1) Note. Graphene is the name given to a single layer of (most commonly) carbon atoms densely packed into a hexagon ring structure; it is widely used to describe properties of many materials including graphite, soot, fullerenes having a caged molecular structure, e.g., buckyballs, nanotubes, and nanococoons, etc.; fullerenes having a curved or partially caged molecular structure, e.g., nanohorns and nanoscrolls, etc.; and fullerenes having a planar molecular structure (although planar graphene itself has been historically presumed to be unstable and typically not existing in the free state).

(2) Note. Fullerene, also called buckminsterfullerene or buckyball, is a large molecule comprised specifically or primarily of carbon atoms and having shape of an empty cage, i.e., carbon cage.

(3) Note. This subclass contains fullerene-like structures that are not strictly carbon-based cage structures, whereas subclass 735 and its indents contain carbon-based fullerenes.

(4) Note. A buckyball having a C_{60}–like molecular structure wherein roughly a quarter or a half of the atoms are non-carbon atoms, e.g., $C_{40}X_{20}$, etc., would be properly classified as a fullerene-like structure.

SEE OR SEARCH THIS CLASS, SUBCLASS:

735, for carbon buckyball.

742, for carbon nanotubes.

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Articles, appropriate subclasses, particularly subclass 408 for self-sustaining carbon mass, e.g., bulk structure or layer comprising fullerene or fullerene-like structures, etc.

735 Carbon buckyball (C_{60}, C_{70}, etc., and derivatives and modifications thereof):
Subject matter under subclass 734 wherein the fullerene specifically has a spherical or quasi-spherical carbon-cage molecular structure.

(1) Note. Carbon-based fullerenes having a C_{60}–like molecular structure wherein several non-carbon atoms substituted for several C atoms, e.g., $C_{57}X_3$, etc., are included in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

734, for fullerene or fullerene-like structures.

741, for carbon cages with compositional substitution.

736 Having atoms interior to the carbon cage:
Subject matter under subclass 735 wherein the buckyball includes additional atoms or molecules, e.g., tri-metallic atom clusters, etc. interior to the carbon-cage structure, e.g., farctate buckyballs, etc.

737 Having a modified surface:
Subject matter under subclass 735 wherein the surface of the buckyball is functionalized with a dissimilar atom or molecule.

738 Modified with biological, organic, or hydrocarbon material:
Subject matter under subclass 737 wherein the surface of the buckyball is functionalized by a material relating to a living organism, or a carbon-based or a hydrocarbon based material.

739 Modified with an enzyme:
Subject matter under subclass 738 wherein the surface of the buckyball is functionalized by an enzyme.

(1) Note. An enzyme is any of numerous proteins or conjugated proteins produced by living organisms functioning as chemical catalysts in living organisms.

740 Modified with atoms or molecules bonded to the surface:
Subject matter under subclass 737 wherein the surface of the buckyball is modified by bonding or attaching a dissimilar atom or molecule to the surface.

741 Modified with dissimilar atom or molecule substituted for carbon atoms of the buckyball (e.g., impurity doping or compositional substitution, etc.):
Subject matter under subclass 737 wherein at least one of the carbon atom constituting the buckyball carbon cage is replaced by a dissimilar atom or molecule.

742 Carbon nanotubes (CNTs):
Subject matter under subclass 734 wherein the fullerene specifically has a cylindrical or tubular (non-spherical) carbon-cage molecular structure.

743 Having specified tube end structure (e.g., close-ended shell or open-ended tube, etc.):
Subject matter under subclass 742 wherein the carbon nanotube end has a particular structure.

744 Having atoms interior to the carbon cage:
Subject matter under subclass 742 wherein the CNT includes an additional atom or molecule interior to the carbon-cage molecular structure, e.g., farctate nanotube, etc.

745 Having a modified surface:
Subject matter under subclass 742 wherein the surface of the CNT is functionalized with a dissimilar atom or molecule.

746 Modified with biological, organic, or hydrocarbon material:
Subject matter under subclass 745 wherein the surface of the CNT is functionalized by a material relating to a living organism, or a carbon-based or hydrocarbon-based material.

747 Modified with an enzyme:
Subject matter under subclass 746 wherein the surface of the CNT is functionalized by an enzyme.

(1) Note. An enzyme is any of numerous proteins or conjugated proteins produced by living organisms functioning as chemical catalysts in living organisms.

748 Modified with atoms or molecules bonded to the surface:
Subject matter under subclass 745 wherein the surface of the CNT is modified by bonding or attaching a dissimilar atom or molecule to the surface.

749 Modified with dissimilar atoms or molecules substituted for carbon atoms of the CNT (e.g., impurity doping or compositional substitution, etc.):
Subject matter under subclass 745 wherein the carbon atom constituting the CNT cage is replaced by a dissimilar atom or molecule.

750 Single-walled:
Subject matter under subclass 742 wherein the CNT possesses only one wrapped layer of graphene.

751 With specified chirality and/or electrical conductivity, (e.g., chirality of (5,4), (5,5), (10,5), etc.):
Subject matter under subclass 750 wherein the single-walled CNT has a specified chirality or bandgap.

(1) Note. Chirality refers to the particular orientation in which the planar carbon sheet, i.e., graphene, is wrapped upon itself. This subclass groups chirality and electrical conductivity together because each chiral species of CNTs has an associated, inherent energy bandgap; and the CNT may also alter the bandgap while functionalizing.

(2) Note. A bandgap is a function of or related to the CNT's chirality.

752 Multi-walled:
Subject matter under subclass 742 wherein the CNT possesses plural, concentrically wrapped layers of graphene.

753 With polymeric or organic binder:
Subject matter under subclass 734 wherein a polymeric, i.e. formed by polymer, or organic, i.e., containing carbon atom, binder serves as a host matrix or adhesive for attaching, bonding or connecting a fullerene structure to other structures, e.g., to other fullerenes, nanosized structures, supporting substrates, conventional structures, etc.

(1) Note. Polymer is a high-molecular-weight natural or synthetic compound composed of repeated linked units, usually comprised of the same chemical elements.

754 Dendrimer (i.e., serially branching or "tree-like" structure):
Subject matter under subclass 700 wherein the nanostructure is a polymer having a serially branching structure, i.e., including a branching structure wherein at least one of the branches, in turn, possesses a second branching structure.

(1) Note. The "serially branching structure" requirement of this subclass is included for the purpose of excluding from this subclass structures that only have one or more non-repeating branches, e.g., a straight-chain hydrocarbon molecule with one or more ethyl groups that are respectively attached only to the hydrocarbon chain itself, etc.

(2) Note. Under this subclass, the n^{th}-order branching structure may be the same as, or different from, the (n^{th}-x)-order branching structure.

755 Nanosheet or quantum barrier/well (i.e., layer structure having one dimension or thickness of 100 nm or less):
Subject matter under subclass 700 wherein only one dimension of the nanostructure is 100 nm or less.

(1) Note. As used herein, "nanosheet," is not only generic to the terms, "quantum well" and "quantum barrier," but also is broader than both of these terms

combined. For a layer to be a "nanosheet," it must merely have a physical thickness of 100 nm or less.

(2) Note. This subclass includes nanosheet or quantum barriers/wells that are not otherwise provided for in the U.S. Patent Classification System.

(3) Note. Class 257, subclasses 9-39 generally takes priority for the classification of quantum-well, quantum-barrier and superlattice structures. To reduce duplication, nanostructures that are classifiable under those subclasses are generally excluded from cross-reference classification under subclass 755 unless some other nanosized structure, feature, or characteristic provides an additional basis for cross-reference classification. Subclasses 758-761 of Class 977 are non-exhaustive examples of nanosized structures, features, and characteristics that would warrant cross-reference classification in the Class 977 schedule.

(4) Note. Class 257, subclasses 94-97 generally takes priority for the classification of double-heterojunction (non quantum-well) light emitting diodes (LEDs) wherein the active layer or any other layer has a sub-100 nm thickness. To reduce duplication, such nanosized layers provided within LEDs should be excluded from cross-reference classification under subclass 755 unless some other nanosized structure, feature, or characteristic provides an additional basis for cross-reference classification.

(5) Note. Class 257, subclasses 183-201 generally takes priority for the classification of all semiconductor devices that have nanosized heterostructure layers. To reduce duplication, such nanosized layers should be excluded from cross-reference classification under 977/755 unless some other nanosized structure, feature or characteristic provides an additional basis for cross-reference classification. This general exclusion specifically includes: (1) nanosized lattice-mismatch or buffer layers (Class 257/190); (2) compositionally-graded layers (Class 257/191) unless the structure is a superlattice with a graded effective bandgap such that classification is proper under 977/760; and (3) nanosized layers that are provided in heterojunction field effect transistors (Class 257/192, 257/194).

756 Lipid layer:
Subject matter under subclass 755 wherein the nanosheet is a nanoscale lipid layer, e.g., lipid monolayer or bilayer, etc.

757 Layer containing protein:
Subject matter under subclass 756 wherein the nanoscale lipid layer contains a protein molecule.

758 Mono-atomic layer or δ–doped (delta-doped) sheet:
Subject matter under subclass 755 wherein the nanosheet specifically has a single atomic layer thickness.

(1) Note. Synonyms of "mono-atomic layer" include "monolayer," "ML" and "delta-doped layer/sheet."

(2) Note. One characteristic setting delta-doped sheets apart from other nanosheets is that the impurity concentrations for δ–doped sheets are most typically (but not

always) set forth in units of atoms/cm^2 (squared) instead of a conventional nanosheet layer's impurity units of atoms/cm^3 (cubed).

759 Quantum well dimensioned for intersubband transitions (e.g., for use in unipolar light emitters or quantum well infrared photodetectors, etc.):
Subject matter under subclass 755 wherein the quantum well has dimensions that enable intrasubband transitions between plural discrete energy levels that exist within either the conduction band alone or the valence band alone (as opposed to interband transitions between the conduction and valence bands).

760 Superlattice with graded effective bandgap (e.g., "CHIRP-graded" superlattice, etc.)
Subject matter under subclass 755 wherein a graded effective bandgap is realized by serially altering the dimensions or compositions of quantum wells or barriers within a superlattice.

(1) Note. Such superlattices are commonly referred to as Coherent Hetero-Interfaces for Reflection and Penetration- or CHIRP-graded superlattices.

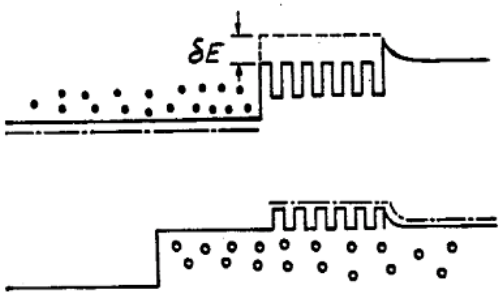
(2) Note. A superlattice is an active layer thin enough to permit carrier transmission.

SEE OR SEARCH THIS CLASS, SUBCLASS:

761, for superlattice with effective bandgap that is greater than the bulk barrier bandgap.

761 Superlattice with well or barrier thickness adapted for increasing the reflection, transmission, or filtering of carriers having energies above the bulk-form conduction or valence band energy level of the well or barrier (i.e., well or barrier with $n_{integer}\lambda_{carrier}/4$ thickness):
Subject matter under subclass 755 including (1) quarter-wave superlattices that increase the reflection of carriers of at least one energy in the classical continuum ($t_{barrier,well} = n_{odd\text{-}integer}\lambda_{carriers}/4$); (2) half-wave superlattices that increase the transmission of carriers of at least one energy in the classical continuum ($t_{barrier,well} = n_{even\text{-}integer}\lambda_{carriers}/4 = n_{integer}\lambda_{carriers}/2$); (3) superlattices including combinations of quarter-wave-thickness and half-wave-thickness regions for filtering carriers of at least one energy in the classical continuum; or (4) superlattices including distinct regions that reflect or transmit carriers of distinct energies for providing a graded effective bandgap that is greater than that of the bulk barrier bandgap.

(1) Note. See the illustration, below, for a graphic example of a quarter-wave-thickness or reflection superlattice wherein the effective conduction-band barrier height is increased above the bulk barrier height by an energy δE, thereby reflecting electrons having energies less than that depicted by the dashed line.



(2) Note. It should be emphasized that the quarter-wavelength thicknesses of the wells or barriers are set according to the wavelength of carriers (i.e., electrons or holes) incident upon the reflection superlattice—NOT the wavelength of any photons/light waves that might be absorbed by, or emitted from, the superlattice or by/from any surrounding areas.

762 Nanowire or quantum wire (axially elongated structure having two dimensions of 100 nm or less):
Subject matter under subclass 700 wherein the nanostructure has two physical dimensions that are of 100 nm or less.

(1) Note. The term, "quantum wire" refers to an elongated structure having a carrier affinity that is larger than that of the material or vacuum that surrounds it, and having a diameter small enough (typically on the order of 20 nm or less) to support discrete or quantized allowed energy levels.

2) Note. As used herein, the term "nanowire," is broader than "quantum wire" because a "nanowire" must merely have a physical diameter that is 100 nm or less. Thus, "nanowire" also reads on various, additional sub-100 nm wires, such as: (1) relatively large electron affinity wires supporting/having overlapping or non-quantized energy levels; or (2) any other sub-100 nm-thick wire irrespective of its carrier affinity relative to its surroundings.

(3) Note. Common synonyms for nanowire or quantum wire include quantum or nanowhiskers, quantum, or nanolines; quantum or nanorods, one-dimensional wires/lines/rods; and one-dimensional wires/lines/rods.

763 Formed along or from crystallographic terraces or ridges:
Subject matter under subclass 762 wherein a nanowire is formed along, atop, or in between the supporting surface of crystallographic terraces or ridges, or wherein these crystallographic terraces or ridges, themselves, form the nanowire.

(1) Note. Crystallographic terraces or ridges are atomic-scale, periodic protrusions that may extend in either a straight or meandering direction along the surface of certain crystalline planes, e.g., along the (5 5 12) plane, etc.

764 With specified packing density:
Subject matter under subclass 762 wherein either a wire array or a surrounding host matrix structure has a specified pitch, i.e. packing density.

765 With specified cross-sectional profile (e.g., belt-shaped, etc.):

Subject matter under subclass 762 wherein the wire has a specified cross-sectional profile, e.g., circular, rectangular or belt-shaped, hexagonal, etc.

766 Bent wire (i.e., having nonlinear longitudinal axis):
Subject matter under subclass 762 wherein the nanowire has a non-linear or non-straight longitudinal axis.

767 Mesh structure:
Subject matter under subclass 766 wherein a plurality of nanowires are interweaved or interlaced.

768 Helical wire:
Subject matter under subclass 766 wherein the longitudinal axis of the nanowire curves is in a spiral configuration.

769 Formed with nucleic acid:
Subject matter under subclass 768 wherein the nanowire is constituted of a nucleic acid.

770 Formed with polyamide polymers:
Subject matter under subclass 768 wherein the nanowire is constituted of a polymer having repeated amide groups (i.e., $CONH_2$ groups).

771 Nanoring:
Subject matter under subclass 766 wherein the longitudinal axis of the nanowire curves in a planar, open-ended, or close-ended circular configuration.

772 Formed from circular biomolecule (e.g., DNA, heme, chelator, etc.):
Subject matter under subclass 771 wherein the nanoring is formed via circular structure biomolecules such as DNA plasmids or vectors, heme-type molecules, or coordination complex molecular structures.

SEE OR SEARCH CLASS:

536, Organic Compounds, subclass 23.1 for general biotechnology plasmids or vectors.

773 Nanoparticle (structure having three dimensions of 100 nm or less):
Subject matter under subclass 700 wherein all three of the nanostructure's physical dimensions are of 100 nm or less.

SEE OR SEARCH THIS CLASS, SUBCLASS:

774, for quantum dots.

774 Exhibiting three-dimensional carrier confinement (e.g., quantum dots, etc.):
Subject matter under subclass 773 wherein the nanoparticle has a carrier affinity that is larger than that of the material or vacuum that surrounds it.

(1) Note. The term "quantum dot" refers to a substantially ball-shaped, cube-shaped, or cluster-shaped structure having a carrier affinity that is larger than that of the material or vacuum that surrounds it, and having a width/diameter small enough (typically on the order of 20 nm or less) to support discrete or quantized allowed energy levels.

(2) Note. As used herein, the term "nanodot," is broader than "quantum dot" because a "nanodot" must merely have a physical diameter that is 100 nm or less. Thus, "nanodot" also reads on various, additional sub-100 nm structures, such as: (1) clusters of atoms which have a relatively large electron affinity but which support non-quantized or overlapping energy levels; or (2) any other sub-100 nm-diameter structure irrespective of its carrier affinity relative to its surroundings.

(3) Note. This subclass is intended to include (1) true "quantum dots" (wherein the energy levels are quantized) and also (2) other dot structures that possess relatively large carrier affinities or that are used for their (semi/)conducting or electronic characteristics, even though the energy levels supported by the dots overlap or are not quantized.

(4) Note. While this schedule distinguishes nanoparticles from quantum dots for classification purposes, many references use these terms interchangeably. Common synonyms for quantum dots include: nanodots, quantum or nanoparticles, quantum or nanoclusters, quantum or nanopowders, artificial atoms, zero-dimensional dots, and 0-D dots.

775 Nanosized powder or flake (e.g., nanosized catalyst, etc.):
Subject matter under subclass 773 wherein the nanoparticle is composed of a nanosized powder or flake, especially stand-alone powders or flakes that are not further disposed, suspended, or dissolved within a host/barrier/matrix composition, compound, or solution.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, appropriate subclasses for subject matter based on metal powder composition.

501, Compositions: Ceramic, appropriate subclasses for subject matter based on metal powder composition.

776 Ceramic powder or flake:
Subject matter under subclass 775 wherein the nanosized powder or flake is composed of a specified ceramic.

777 Metallic powder or flake:
Subject matter under subclass 775 wherein the nanosized powder or flake is specifically composed of a specified metallic composition or alloy.

778 Within specified host or matrix material (e.g., nanocomposite films, etc.):
Subject matter under subclass 700 directed towards a specified host/barrier/matrix composition, compound, or solution in which at least one nanosized structure, e.g., fullerene, nanowire, etc., is formed, disposed, suspended, or dissolved.

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Articles, appropriate subclasses, particularly subclasses 323-331 for layer containing structurally defined particles and subclasses 411.1-704 for non-structural laminates.

779 Possessing nanosized particles, powders, flakes, or clusters other than simple atomic impurity doping:
Subject matter under subclass 778 wherein the host/barrier/matrix composition, compound or solution possesses a nanostructure of specified composition wherein all three dimensions are of 100 nm or less.

(1) Note. Simple atomic, impurity doping is excluded from coverage because this would read on virtually every solid-state semiconductor device, as they are all doped with shallow-level impurities (i.e., n-doped or p-doped) and/or deep-level impurities.

780 Possessing fully enclosed nanosized voids or physical holes:
Subject matter under subclass 778 wherein the host/barrier/matrix composition, compound or solution contains a fullyenclosed nanosized physical hole, void or bubble of gas or vacuum.

(1) Note. “Physical hole” as used in this subclass is distinguished from the meaning of “hole” as commonly employed in semiconductor physics to mean the absence of an electron.

781 Possessing nanosized surface openings that extend partially into or completely through the host material:
Subject matter under subclass 778 wherein the host/barrier/matrix composition or compound has a surface that contains downward-extending, nanosized physical concavity, depression, recess, groove, via-hole, or pore that is not fully enclosed.

782 Possessing nanosized physical convexity, ridge, or protrusion extending upward from the host’s surface:
Subject matter under subclass 778 wherein the host/barrier/matrix composition or compound contains a nanosized physical, convexity, ridge protrusion, or bump extending upward from surface.

783 Organic host/matrix (e.g., lipid, etc.):
Subject matter under subclass 778 wherein the nanosized structure is a host/barrier/matrix composition, e.g., a lipid layer, etc., or a compound or solution related to or derived from an organic source, such as a living organism, which contains within the host or layer other components which may or may not be nanomaterials, e.g., proteins present in a lipid bilayer, etc.

784 Electrically conducting, semi-conducting, or semi-insulating host material:
Subject matter under subclass 778 wherein the host/barrier/matrix composition, compound, or solution has the ability to transmit or conduct electrical current; i.e., electrically conducting, semi-conducting, or semi-insulating.

785 Electrically insulating host material:
Subject matter under subclass 778 wherein the host/barrier/matrix composition, compound or solution is unable to transmit or conduct electrical current; i.e., electrically insulating.

786 Fluidic host/matrix containing nanomaterials:
Subject matter under subclass 778 wherein the host/matrix constitutes a substance that can flow, i.e., fluidic substance such as liquid or gas, in which nanostructures are present, e.g., nanoparticles in an aqueous solution, etc.

787 Viscous fluid host/matrix containing nanomaterials:
Subject matter under subclass 786 wherein the fluidic substance wherein nanostructures are present has a relatively high resistance to flow.

788 Of specified organic or carbon-based composition:
Subject matter under subclass 700 wherein either (1) a nanostructure itself is composed of an organic carbon-based material/composition, or (2) a substrate or host structure is composed of an organic carbon-based material and is specifically adapted for bonding with, supporting or containing a nanostructure.

(1) Note. This subclass and its indents are intended to broadly cover organic or carbon-based chemical structures, materials or compositions that constitute, include, or are specifically attached to nanosized structures.

(2) Note. This subclass and its indents exclude inorganic carbon based structures, compositions or materials, such as carbon-based fullerenes and $C_xSi_yGe_z$ compounds.

SEE OR SEARCH THIS CLASS, SUBCLASS:

734, for fullerenes.

814, for inorganic $C_xSi_yGe_z$ compounds.

789 In array format:
Subject matter under subclass 788 wherein the organic carbon based nanostructures are orderly arranged in some type of pattern.

790 With heterogeneous nanostructures:
Subject matter under subclass 789 wherein the array consists of dissimilar organic carbon-based nanostructures, e.g., biological entity particles like proteins, etc.

791 Molecular array:
Subject matter under subclass 790 wherein the organic carbon-based nanostructures have different molecular structures.

792 Nucleic acid array (e.g., human genome array, etc.):
Subject matter under subclass 791 wherein the organic carbon-based nanostructures are dissimilar nucleic acids.

793 Protein array:
Subject matter under subclass 791 wherein the organic carbon-based nanostructures are dissimilar proteins.

794 Chemical library array:
Subject matter under subclass 790 wherein the organic carbon-based nanostructures are different in chemical properties, generally not biological in nature.

795 Composed of biological material:
Subject matter under subclass 788 wherein the organic carbon-based material or composition is relating to or derived from a living organism.

796 **For electrical or electronic purpose:**
Subject matter under subclass 795 wherein the biological material or composition possesses a specified electrical property or is used within an electronic device or for an electro-biological application.

797 **Lipid particle:**
Subject matter under subclass 788 wherein the organic carbon-based nanostructures is a lipid particle type material, e.g., vesicle or spherical lipid structure, etc.

798 **Having internalized material:**
Subject matter under subclass 797 wherein the lipid particle contains another material inside its structure or boundary, e.g., spherical container, etc.

799 **Containing biological material:**
Subject matter under subclass 798 wherein the material that is internalized in the lipid particle is derived from or relating to a living organism.

800 **Nucleic acid (e.g., DNA or RNA, etc.):**
Subject matter under subclass 799 wherein the biological material internalized in the lipid particle is a nucleic acid.

801 **Drug:**
Subject matter under subclass 799 wherein the biological material internalized in the lipid particle is a medicine, i.e., a chemical substance utilized in biological disease or condition treatment.

802 **Virus-based particle:**
Subject matter under subclass 788 wherein the nanostructure composition is made up virus or viral particle.

803 **Containing biological material in its interior:**
Subject matter under subclass 802 wherein a material that is internalized within a virus interior space is derived from or relating to a living organism.

804 **Containing nucleic acid:**
Subject matter under subclass 803 wherein the biological material is a nucleic acid.

805 **Containing drug:**
Subject matter under subclass 803 wherein the biological material is a medicine, i.e., a chemical substance utilized in biological disease or condition treatment.

806 **With exterior chemical attachment:**
Subject matter under subclass 802 wherein the virus based particle is externally modified with a chemical attachment, e.g., display phage modification, etc.

807 **Exterior attachment for detection:**
Subject matter under subclass 806 wherein the exterior chemical attachment is adapted for a tracking purpose, e.g., used for recognizing the virus-based particle, etc.

808 **Exterior attachment for targeting (e.g., drug targeting, etc.):**
Subject matter under subclass 806 wherein the exterior chemical attachment is adapted for directing the virus based particle to a target site, e.g., chemical delivery to a specific site for therapeutic purposes, etc.

809 Organic film on silicon:
Subject matter under subclass 788 wherein the organic material or composition is specifically formed on a doped or undoped silicon layer/substrate, either directly or indirectly by means of an intermediate/buffer layer.

SEE OR SEARCH CLASS:

428, Stock materials or Miscellaneous Articles, appropriate subclasses, particularly subclass 446 and subclass 451 for laminates comprising a layer of silicon and a layer of silicon next to addition polymers.

810 Of specified metal or metal alloy composition:
Subject matter under subclass 700 wherein the nanostructure is constituted of or surrounded by a material that is a metal or a metal alloy.

SEE OR SEARCH CLASS:

420, Alloys or Metallic Compositions, appropriate subclasses for alloy compositions.

428, Stock Materials or Miscellaneous Articles, appropriate subclasses, particularly subclasses 544-687 for structures of all metal or with adjacent metals.

811 Of specified metal oxide composition (e.g., conducting or semiconducting compositions such as ITO, ZnOx, etc.):
Subject matter under subclass 700 wherein the nanostructure is composed of, includes, or is surrounded by a material that is specifically composed of a metal oxide.

812 Perovskites and superconducting composition (e.g., $Ba_xSr_{1-x}TiO_3$, etc.):
Subject matter under subclass 811 wherein the metal oxide is specifically composed of a perovskite or superconductor material.

813 Of specified inorganic semiconductor composition (e.g., periodic table group IV-VI compositions, etc.):
Subject matter under subclass 700 wherein at least one nanostructure is composed of, includes, or is surrounded by a material that is specifically composed of an inorganic semiconductor material, regardless of whether this material is degeneratively doped, moderately doped, lightly doped or undoped.

SEE OR SEARCH CLASS:

428, Stock Materials or Miscellaneous Articles, particularly subclasses 688-703 for non-structural laminates of inorganic materials and subclass 620 for all metal composites where one of the layers is a semiconductor layer.

814 Group IV based elements and compounds (e.g., $C_xSi_yGe_z$, porous silicone, etc.):
Subject matter under subclass 813 wherein the inorganic semiconductor material is specifically a group IV element or alloy.

(1) Note. Examples include $C_xSi_yGe_z$,wherein $0 \leq x, y, z \leq 1$ and $x + y + z = 1$.

815 Group III-V based compounds (e.g., $Al_aGa_bIn_cN_xP_yAs_z$ etc.):
Subject matter under subclass 813 wherein semiconductor-based material is specifically composed of a periodic table Group III-V semiconductor compound or alloy.

816 III-N based compounds (e.g., $Al_xGa_yIn_zN$, etc.):
Subject matter under subclass 815 wherein group III-V semiconductor-based material is specifically composed of a nitride-based semiconductor compound or alloy.

(1) Note. Examples include $Al_xGa_yIn_zN$, wherein $0 \leq x, y, z \leq 1$ and $x + y + z = 1$.

817 High-indium-content InGaN pooling or clusters:
Subject matter under subclass 816 wherein the InGaN-based semiconductor material has an In concentration that is sufficiently high, e.g., In concentration approximately on the order of $In_{0.1}Ga_{0.9}N$ to $In_{0.4}Ga_{0.6}N$, or higher, etc., so as to produce an In pooling or clustering effect, i.e., wherein the layer separates into clusters or regions of relatively high In concentration (quantum or potential wells) and surrounding regions of relatively low In concentration (quantum or potential barriers).

818 III-P based compounds (e.g., $Al_xGa_yIn_zP$, etc.):
Subject matter under subclass 815 wherein group III-V semiconductor-based material is specifically composed of a phosphide-based semiconductor compound or alloy.

(1) Note. Examples include $Al_xGa_yIn_zP$, wherein $0 \leq x, y, z \leq 1$ and $x + y + z = 1$.

819 III-As based compounds (e.g., $Al_x Ga_y In_z As$, etc.):
Subject matter under subclass 815 wherein group III-V semiconductor-based material is specifically composed of an arsenide-based semiconductor compound or alloy.

(1) Note. Examples include $Al_x Ga_y In_z As$, wherein $0 \leq x , y , z \leq 1$ and $x + y + z = 1$.

820 III-Sb based compounds (e.g., $Al_x Ga_y In_z Sb$, etc.):
Subject matter under subclass 815 wherein group III-V semiconductor-based material is specifically composed of an antimonide-based semiconductor compound or alloy.

(1) Note. Examples include $Al_x Ga_y In_z Sb$, wherein $0 \leq x, y, z \leq 1$ and $x + y + z = 1$.

821 Mixed group V compounds (e.g., III-N_xP_y, etc.):
Subject matter under subclass 815 wherein group III-V semiconductor-based material is specifically composed of plural group V elements, irrespective whether the compound includes one or plural group III elements.

(1) Note. Examples include $Al_aGa_bIn_cN_xP_yAs_z$, wherein $0 \leq a, b, c \leq 1$, $a + b + c = 1$; and $0 < x, y, z < 1$ and $x + y + z = 1$.

822 Boron-containing compounds:
Subject matter under subclass 815 wherein group III-V compound semiconductor material specifically includes boron (B) as a compositional (/non-dopant) element.

(1) Note. Examples include alloys of B(Al)(Ga)N (or $B_aAl_bGa_cN$, wherein $0 < a \leq 1$; $0 \leq b, c < 1$; and $a + b + c = 1$).

(2) Note. Specifically excluded from this subclass are semiconductor elements or compounds that have such a small amount of boron that the boron present

merely constitutes an impurity, e.g., on the order of 1e20 atoms/cm^3 or less, etc., in a non-carbon composition, e.g., boron-doped SiGe, etc.

823 Tl-containing or Bi-containing compounds:
Subject matter under subclass 815 wherein group III-V compound semiconductor material specifically includes thallium (Tl) and/or bismuth (Bi) as compositional (/non-dopant) element(s).

(1) Note. Specifically excluded from this subclass are semiconductor elements or compounds that have such a small amount of thallium or bismuth that the atoms of these elements present merely constitute impurities, e.g., on the order of 1e20 atoms/cm^3 or less, etc., in a non-bismuth, non-thallium composition, e.g., thallium doped or bismuth-doped SiGe, etc.

824 Group II-VI nonoxide compounds (e.g., Cd_xMn_yTe, etc.) :
Subject matter under subclass 813 wherein the compound semiconductor is specifically composed of group II-VI elements other than oxide-based II-VI compounds.

SEE OR SEARCH THIS CLASS, SUBCLASS:

811, for oxide-based compounds or metal oxide nanomaterial, e.g., ITO, ZnOx, etc.

812, for Perovskites and superconducting materials, e.g., $Ba_xSr_{1-x}TiO_3$, etc.

825 Heterojunction formed between semiconductor materials that differ in that they belong to different periodic table groups (e.g., Ge (Group IV) - GaAs (Group III-V) or InP (group III-V) - CdTe (Group II-VI), etc.):
Subject matter under subclass 813 wherein the nanostructure includes at least one heterojunction composed of two adjacent semiconductor layers that belong to different periodic table-group families.

826 Nonstoichiometric semiconductor compounds (e.g., III_xV_y; $x \neq y$, etc.):
Subject matter under subclass 813 wherein the compound semiconductor has a substantially non-stoichiometric composition: i.e., wherein the composition's net charge is NOT substantially equal to 0.

(1) Note. Examples include III_xV_y or II_xVI_y; $x \neq y$.

(2) Note. Excluded from this subclass are substantially stoichiometric compound semiconductors that are merely p-doped or n-doped.

827 Formed from hybrid organic/inorganic semiconductor compositions:
Subject matter under subclass 700 wherein the nanosized structure or device is composed of, or includes, a first structure, region or portion that is composed of an organic material/composition (whether biological or not), and a second structure, region or portion that is composed of, or includes, an inorganic semiconductor material/composition.

(1) Note. The subclass is intended to generally cover all organic materials/compositions that are interconnected to, or functionally associated with, inorganic semiconductors regardless of whether the organic material/composition, itself, also possesses semiconducting properties.

SEE OR SEARCH THIS CLASS, SUBCLASS:

734, for fullerene and fullerene-like structures.

738, for buckyball nanostructure having a surface functionalized with an organic material.

746, for carbon nanotube structure having a surface functionalized with an organic material.

753, for carbon fullerenes having a polymeric or organic binder.

827, for hybrid organic/inorganic semiconductor structures in the event that the inorganic material/composition is specifically a fullerene or fullerene-like structure.

828 Biological composition interconnected with inorganic material:
Subject matter under subclass 827 wherein the organic material/composition portion is specifically a biological material/composition.

829 Organic or biological core coated with inorganic shell:
Subject matter under subclass 827 wherein the organic material/composition forms a central core or nucleus that is substantially or entirely surrounded by, or coated with an inorganic material.

830 Inorganic core or cluster coated with organic or biological shell:
Subject matter under subclass 827 wherein the inorganic material forms a central core or nucleus that is substantially or entirely surrounded by, or coated with a shell of organic or biological material.

831 Of specified ceramic or electrically insulating compositions:
Subject matter under subclass 700 wherein the nanostructure is composed of a ceramic or other insulating materials/compounds, (e.g., a ceramic nanopowder composed of a specified material, etc).

SEE OR SEARCH CLASS:

428, Stock Materials or Miscellaneous Articles, particularly subclasses 689-703 for Non- structural laminates of inorganic metal compound containing layer, e.g. ceramics, etc.

832 Having specified property (e.g., lattice-constant, thermal expansion coefficient, etc.):
Subject matter under subclass 700 wherein the material constituting the nanostructure or nanodevice possesses a specified physical property.

SEE OR SEARCH THIS CLASS, SUBCLASS:

776, for ceramic, e.g., electrically insulating, etc., nanosized powder or flake.

777, for metallic, e.g., electrically conducting, etc., nanosized powder or flake.

796, for organic, biological or polymeric carbon-based composition with electrical property or for electronic purposes.

810, for metal, e.g., electrically conducting, etc., nanomaterial.

811, for metal oxide, e.g., electrically conducting or semiconducting, etc., nanomaterial.

813, for inorganic semiconducting nanomaterial.

827, for hybrid organic/inorganic semiconducting nanomaterial.

831, for electrically insulating nanomaterial.

784, for electrically conducting, semi-conducting or semi-insulating host material in which nanosized material is disposed.

785, for electrically insulating host material in which nanosized material is disposed.

833 Thermal property of nanomaterial (e.g., thermally conducting/insulating or exhibiting Peltier or Seebeck effect, etc.):
Subject matter under subclass 832 wherein the specified physical property of the material is relating to or caused by heat.

834 Optical properties of nanomaterial (e.g., specified transparency, opacity, or index of refraction, etc.):
Subject matter under subclass 832 wherein the specified physical property of the material is an optical property, e.g., refractive, reflective, etc.

835 Chemical or nuclear reactivity/stability of composition or compound forming nanomaterial:
Subject matter under subclass 832 wherein the specified physical property of the material is relating to its chemical or nuclear reactivity or stability.

836 Having biological reactive capability:
Subject matter under subclass 835 wherein the physical property is characterized by its function of reacting with a living organism, e.g., reacts with a particular biological target, such as a cancer cell, etc.

837 Piezoelectric property of nanomaterial:
Subject matter under subclass 832 wherein the specified physical property of the material is its capability of generating electrical signal subjected to a mechanical tress or capability of generating a mechanical stress subjected to an applied voltage, i.e. piezoelectric property.

838 Magnetic property of nanomaterial:
Subject matter under subclass 832 wherein the specified physical property of the material is an electromagnetic property.

839 MATHEMATICAL ALGORITHMS, E.G., COMPUTER SOFTWARE, ETC., SPECIFICALLY ADAPTED FOR MODELING CONFIGURATIONS OR PROPERTIES OF NANOSTRUCTURE:
Subject matter under the class definition directed to the theoretical modeling of a nanostructure's configuration or associated physical properties, as opposed to physical structures, themselves.

(1) Note: Tools, aids and means specifically designed or intended for carrying out, or assisting in, the modeling of nanostructures are also included in this subclass.

840 MANUFACTURE, TREATMENT, OR DETECTION OF NANOSTRUCTURE:
Subject matter under the class definition directed to a process or an apparatus for making a nanostructure, altering a nanostructure, or determining a characteristic of a nanostructure.

(1) Note: The apparatus performing the manufacture, treatment, or detection of the nanostructure is not limited to the nanoscale and may include structure of macroscopic dimensions such as in a scanning probe.

(2) Note: The detection of 840 is distinct from the detection under 953 in that the focus of 840 is on nanostructures as the object of detection whereas the focus of 953 is on nanostructures as the objects doing the detecting.

841 Environmental containment or disposal of nanostructure material:
Subject matter under 840 for the confinement of nanostructure material so as to minimize dispersal into the environment, or for the removal of nanostructure material from the environment.

(1) Note. The disposal may be, for example, the conversion of the nanostructure by chemical or physical means to a less harmful form, which may be safely disposed of in an ordinary municipal landfill.

(2) Note. This subclass does not include nanofiltration processes for removing bacteria from air/etc

SEE OR SEARCH CLASS:

588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for processes for the destruction or containment of hazardous materials.

842 For carbon nanotubes or fullerenes:
Subject matter under subclass 840 wherein the nanostructure is a fullerene or a carbon nanotube.

843 Gas Phase Catalytic Growth (i.e., chemical vapor deposition):
Subject matter under subclass 842 wherein the fullerene or nanotube structure is grown by a process that involves the contact of a carbon-containing gas and a catalyst material under heated conditions.

844 Growth by vaporization or dissociation of carbon source using a high-energy heat source (e.g., electric arc, laser, plasma, e-beam, etc.):
Subject matter under subclass 842 wherein the fullerene or nanotube structure is grown by a process that involves using a high-energy heat source to vaporize a carbon target or dissociate a carbon source into its elemental components, whereby the nanostructure is produced under the high-energy conditions, with or without the aid of a catalyst.

845 Purification or separation of fullerenes or nanotubes:
Subject matter under subclass 842 wherein the process or apparatus is adapted to extract the fullerene or nanotube from the material that accompanies the growth process (e.g. residual catalyst, amorphous carbon, graphite) or to sort or divide the fullerene or nanotube based upon their physical or chemical properties (e.g. separation by size, chirality, etc.)

846 Internal modifications (e.g., filling, endohedral modifications, etc.):
Subject matter under subclass 842 wherein the process or apparatus is adapted to treat the region inside the carbon cage of the fullerene or nanotube.

(1) Note: This includes the processes or apparatuses that treat the opening or closing of the nanotube.

847 Surface modifications (e.g., functionalization, coating, etc.):
Subject matter under subclass 842 wherein the process or apparatus is adapted to treat the surface of the carbon cage of the fullerene or nanotube or the surface of the nanostructure itself.

848 Tube end modifications (e.g., capping, joining, splicing, etc.):
Subject matter under subclass 842 wherein the process or apparatus is adapted to treat the nanotube that affects the end of the tube or the tube cap.

849 With scanning probe:
Subject matter under 840 including a device having at least a tip of nanometer sized dimensions capable of performing manufacture, treatment, or detection in the nanometer range, e.g., scanning tunneling microscope (STM), atomic force microscope (AFM), magnetic force microscope (MFM), and near-field optical scanning probe etc.

850 Scanning probe control process:
Subject matter under subclass 849 including a control method of using a scanning probe in manufacture, treatment, or detection of nanostructures.

851 Particular movement or positioning of scanning tip:
Subject matter under subclass 850 including specified details of the movement or positioning of the scanning probe tip relative to the object being detected or processed (e.g. tapping mode, non-contact, positioning feedback control, etc.).

852 For detection of specific nanostructure sample or nanostructure–related property:
Subject matter under subclass 849 wherein the scanning probe is used to detect a particular sample or to measure a particular nanoscale property of the sample, e.g., shape, resistivity, charge density, etc.

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclasses 649, 774, 324-862.325 and 866.5 for structure of sensors.

250, Radiant Energy, subclasses 227.11, 309-311, and 341.2 for probe types used in solid or liquid sample detection.

324, Electricity: Measuring and Testing, subclasses 72.5, 149, 437, 445-446, 690, 696, 715, 724, and 751-754 for probe types used in detection processes of electrical properties of a sample.

338, Electrical Resistors, subclasses 28 and 229 for resistor probes.

853 Biological sample:
Subject matter under 852 wherein the sample is biological in nature.

SEE OR SEARCH CLASS:

435, Chemistry: Molecular Biology and Microbiology, subclasses 4-40.52 and 287.1-288.7 for detection of biological samples.

436, Chemistry: Analytical and Immunological Testing, subclasses 28,37, and 63 for detection of biological samples.

702, Data Processing: Measuring, Calibrating, or Testing, subclasses 19-21 for methods and apparatus utilizing a data processing system in a measurement system directed to an environment of life or chemical compound or process in a living system.

854 Semiconductor sample:
Subject matter under 852 wherein the sample is a semiconductor material.

SEE OR SEARCH CLASS:

438, Semiconductor Device Manufacturing: Process, subclasses 14-18 for semiconductor measuring and testing.

855 For manufacture of nanostructure:
Subject matter under subclass 849 wherein the scanning probe tip is used in a manufacturing process of nanostructure.

856 Including etching/cutting:
Subject matter under subclass 855 wherein the scanning probe tip is used for removing material from a substrate, forming grooves or indents in a substrate, or cutting a nanostructure.

SEE OR SEARCH CLASS:

216, Etching a Substrate: Processes, subclasses 12-19, 39-40, 57-58, 72-81, and 96-100 for different types of substrate etching.

857 Including coating:
Subject matter under subclass 855 wherein the scanning probe tip is used for depositing material on a substrate (such as in dip pen nanolithography).

SEE OR SEARCH CLASS:

427, Coating Processes, subclasses 457-601 for coating processes involving direct application of electrical or magnetic, waves, or particulate energy.

858 Including positioning/mounting nanostructure:
Subject matter under subclass 855 wherein the scanning probe tip is used for positioning or mounting nanostructure on a substrate.

859 Including substrate treatment:
Subject matter under subclass 855 wherein the scanning probe tip is used to form or modify nanostructure on a substrate by modify the characteristic of the substrate, e.g., scanning probe tip is used to modify a chemical, thermal, electrical, magnetic, or other property of the substrate, etc.

860 Scanning probe structure:
Subject matter under 849 including structural details of the scanning probe.

861 Scanning tunneling probe:
Subject matter under 860 wherein the scanning probe is constructed to operate based upon a quantum tunneling effect in which the probability of electron transmission between the tip and an object being manufactured, treated, or detected is related to a gap between the tip and the object.

862 Near-field probe:
Subject matter under 860 wherein the tip is formed with an integral waveguide wherein the diameter of the waveguide is smaller than the wavelength of the wave propagated in the waveguide.

863 Atomic force probe:
Subject matter under 860 wherein the scanning probe is constructed to operate based upon interaction forces between atoms such as Van der Waals forces between the tip and an object being manufactured, treated, or detected.

(1) Note: Van der Waals force (aka London or dispersion force) is an induced dipole - induced dipole interaction that depends on the polarization ability of the interacting molecules and is inversely proportional to the sixth power of separation.

864 Electrostatic force probe:
Subject matter under 860 wherein the scanning probe is constructed to operate based upon electrostatic forces between the tip and an object being manufactured, treated, or detected.

(1) Note. Electrostatic force generally results from static charges within one material reacting with an electric field generated by another material.

SEE OR SEARCH CLASS:

324, Electricity: Measuring and Testing, subclasses 452-457 and 709 for electrostatic force measurements.

865 Magnetic force probe:
Subject matter under 860 wherein the scanning probe is constructed to operate based upon magnetic forces between the tip and an object being manufactured, treated, or detected.

(1) Note. Magnetic force generally results from currents, or moving charges, within one material reacting with an external magnetic field generated by another material such as iron or nickel based materials that have intrinsic magnetic properties.

SEE OR SEARCH CLASS:

324, Electricity: Measuring and Testing, subclasses 200-263 for magnetic measurements.

866 Scanning capacitance probe:
Subject matter under 860 wherein the scanning probe is constructed to operate based upon a capacitive effect between the tip and an object being manufactured, treated, or detected.

(1) Note: The capacitive effect is a change in capacitance which occurs when the distance between the tip, acting as a first electrode of a capacitor, and the object, acting as a second electrode of a capacitor, changes as the tip is scanned relative to the object.

SEE OR SEARCH CLASS:

324, Electricity: Measuring and Testing, appropriate subclasses for capacitive measurements.

867 Scanning thermal probe:
Subject matter under subclass 860 wherein the scanning probe is constructed to operate based upon a thermal effect between the tip and an object being manufactured, treated, or detected.

(1) Note. The thermal effect may be a heating of the object by the tip or a temperature detection of the object by the tip or a combination of both heating and temperature detection between the tip and object as the tip is scanned relative to the object.

SEE OR SEARCH CLASS:

374, Thermal Measuring and Testing, subclasses 35 and 164 for thermal sensors including probe.

868 With optical means:
Subject matter under subclass 860 including optical means to facilitate the operation of the scanning probe.

SEE OR SEARCH CLASS:

356, Optics: Measuring and Testing, subclass 451 for spectroscopy, and subclass 501 for an interferometer device usable with an atomic force microscope.

359, Optical: Systems and Elements, subclasses 362-435 for optical elements used in detecting devices.

869 Optical microscope:
Subject matter under subclass 868 wherein the scanning probe is combined with an optical microscope that examines a sample being manufactured, detected, or treated by the scanning probe tip.

870 Optical lever arm for reflecting light:
Subject matter under subclass 868 wherein the optical means is used to reflect light from a holder of the scanning probe tip.

871 With environmental regulation means:
Subject matter under subclass 860 including means to adjust temperature, pressure, humidity, or other environmental factors of the scanning probe.

872 Positioner:
Subject matter under subclass 860 including details of a mechanism such as a piezoelectric, electrostatic, magnetic, or other type of actuator that adjusts the position of the tip relative to the nanostructure being manufactured, detected, or treated.

SEE OR SEARCH CLASS:

310, Electrical Generator or Motor Structure, appropriate subclasses for positioning mechanisms, and subclasses 311–371 for piezoelectric elements.

873 Tip holder:
Subject matter under subclass 860 including a projecting member such as a cantilever that maintains the tip of the probe.

874 Probe tip array:
Subject matter under subclass 860 including a plurality of scanning probe tips.

875 With tip detail:
Subject matter under subclass 860 including structural characteristics of the tip of the scanning probe, i.e. material, shape, surface treatment, or chemical functionalizing of the tip.

876 Nanotube tip:
Subject matter under subclass 875 wherein the tip includes a nanotube.

877 Chemically functionalized:
Subject matter under subclass 875 wherein the tip is chemically modified to react with a certain type of nanostructure.

878 Shape/taper:
Subject matter under subclass 875 wherein the physical form of the tip or the degree of slope or angle of the tip is specified.

879 Material:
Subject matter under subclass 875 wherein the material forming the tip is specified.

880 With arrangement, process, or apparatus for testing:
Subject matter under subclass 840 including process or apparatus for detecting or testing a nanostructure.

SEE OR SEARCH THIS CLASS, SUBCLASS:

852, for detection of specific sample using scanning probe.

SEE OR SEARCH CLASS:

73, Measuring and Testing, for a method and/or apparatus for testing.

324, Electricity: Measuring and Testing, appropriate subclasses for a method and/or apparatus for electrical testing.

356, Optics: Measuring and Testing, appropriate subclasses for optical measuring and testing.

435, Chemistry: Molecular Biology and Microbiology, appropriate subclasses for a method and/or apparatus for molecular biological and/or microbiological testing.

436, Chemistry: Analytical and Immunological Testing, appropriate subclasses for a method and/or apparatus for chemical and immunological testing.

881 Microscopy or spectroscopy (e.g., SEM, TEM, etc.):
Subject matter under subclass 880 wherein a microscopy instrument such as an electron microscope or a spectroscopic device is used to measure or test the nanostructure.

SEE OR SEARCH CLASS:

250, Radiant Energy, subclass 311 for electron microscopes.

356, Optics: Measuring and Testing, subclass 300 for a spectroscope.

359, Optical: Systems and Elements, subclass 368 for a microscope.

882 Assembling of separate components (e.g., by attaching, etc.):
Subject matter under subclass 840 including process or apparatus for bringing together distinct parts to make a desired nanostructure.

883 Fluidic self-assembly (FSA):
Subject matter under subclass 882 wherein a gas or liquid, i.e., a fluid, carrying a plurality of nanostructures is flowed over a substrate in a manner that causes the nanostructures to be simultaneously deposited into selected locations on the substrate's surface.

884 Assembled via biorecognition entity:
Subject matter under subclass 882 wherein molecular biology identification entity i.e., biorecognition entity, is utilized for attaching separate components together, e.g., protein/ligand binding pair, the electrodeposition of the biorecognition nanomodules in self-assembling, etc.

885 Via nucleic acid hybridization:
Subject matter under subclass 884 wherein the biorecognition utilizes nucleic acid hybridization, e.g., nucleic acid polymer hybridization to its complementary polymeric strand forming double-stranded nucleic acid structure, etc.

886 Via protein recognition:
Subject matter under subclass 884 wherein biorecognition utilizes protein substrate or binding site recognition for attaching separate components, e.g., protein receptor/ligand binding or protein/enzyme substrate binding recognition, etc.

887 Nanoimprint lithography (i.e., nanostamp):
Subject matter under subclass 840 wherein manufacturing of the nanostructure includes a mold or stamp used to transfer pattern of nanometer dimensions onto a substrate.

888 Shaping or removal of materials (e.g., etching, etc.):
Subject matter under subclass 840 including process or apparatus for forming a nanostructure by removing material from the nanostructure.

SEE OR SEARCH CLASS:

204, Chemistry: Electrical and Wave Energy, subclass 192.32 for a process of sputter etching.

216, Etching A Substrate: Processes, particularly subclass 63 for a process of gas phase etching of a substrate involving the application of energy to the gaseous etchant or to the substrate being etched .

889 By laser ablation:
Subject matter under subclass 888 wherein the material removing is done by focusing coherent electromagnetic radiation, i.e., laser, onto the surface of the nanostructure.

SEE OR SEARCH CLASS:

219, Electric Heating , subclasses 121.67-121.69 for the shaping of an article by removing a portion by electrical or wave energy, e.g., laser ablation wherein no chemical etchant is employed, etc.

890 Deposition of materials (e.g., coating, CVD, or ALD, etc.):
Subject matter under subclass 840 including process or apparatus for layering or coating to form a nanostructure.

(1) Note. The deposition could be performed by chemical vapor deposition, i.e., CVD, or atomic layer deposition, i.e., ALD.

SEE OR SEARCH CLASS:

118, Coating Apparatus, subclasses 620-643 for coating apparatus with means to apply electrical or magnetic wave or particulate energy.

427, Coating Processes, subclasses 457-601 for coating processes with direct application of electrical or magnetic wave or particulate energy.

891 Vapor phase deposition:
Subject matter under subclass 890 wherein the coating material is in a gaseous state.

SEE OR SEARCH CLASS:

118, Coating Apparatus, subclasses 715-733 for vapor phase coating apparatus.

427, Coating Processes, subclasses 248.1-255.7 for vapor phase coating processes.

892 Liquid phase deposition:
Subject matter under subclass 890 wherein the coating material is in a liquid state.

SEE OR SEARCH CLASS:

118, Coating Apparatus, subclasses 29, 73, 400, and 429 for liquid phase coating apparatus.

427, Coating Processes, subclasses 475, 483, and 581 for liquid phase coating processes.

893 Deposition in pores (molding) with subsequent removal of mold:
Subject matter under subclass 890 wherein pores are deposited with nanomaterial that is subsequently freed via removal of the surrounding molding material, e.g., molding in the nanosized pores of a membrane which may be dissolved, etc.

894 Having step or means utilizing biological growth:
Subject matter under subclass 840 wherein the process or apparatus uses a living organism growth process or growth behavior to manufacture, treat, or detect a nanostructure.

SEE OR SEARCH CLASS:

435, Chemistry: Molecular Biology and Microbiology, subclasses 243, 325, 440, and 283.1 for method or apparatus of propagating a microorganism.

895 Having step or means utilizing chemical property:
Subject matter under subclass 840 wherein the process or apparatus uses chemical factors of an element or compound, e.g., chemical reactions, etc. to manufacture, treat, or detect a nanostructure.

896 Chemical synthesis (e.g., chemical bonding or breaking, etc.):
Subject matter under subclass 895 wherein the process or apparatus uses chemical synthesis to manufacture a nanostructure.

(1) Note. The chemical synthesis is a process of uniting chemical elements or simpler compounds, or by the degrading a compound, i.e., process typically occurs by bonding chemicals or by breaking up chemical compounds, combination reaction process, or process of creating a chemical compound involving plural chemical reactions.

897 Polymerization:
Subject matter under subclass 896 wherein a nanostructure is formed via a chemical process that links two or more monomers together to form a polymer.

898 Enzymatic:
Subject matter under subclass 896 wherein the chemical synthesis utilizes proteins or conjugated proteins produced by living organisms and functioning as catalysts in chemical reactions to manufacture nanostructure.

SEE OR SEARCH CLASS:

435, Chemistry: Molecular Biology and Microbiology, subclasses 183-234 for an enzyme, per se.

899 Electrolytic:
Subject matter under subclass 896 wherein the process or apparatus involves electrolysis of a chemical element to manufacture a nanostructure.

(1) Note. Electrolysis is a process including conduction of an electric current between two or more electrodes through a substance (an electrolyte) and resulting in a chemical change, e.g., oxidation, reduction, etc.

SEE OR SEARCH CLASS:

205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, subclasses 80, 334, 640, and 687 for electrolytic process or composition.

900 Having step or means utilizing mechanical or thermal property (e.g., pressure, heat, etc.)
Subject matter under subclass 840 including process or apparatus that uses solely mechanical means, e.g., pressing or grinding, etc., or thermal means, e.g., heating or curing, etc., to manufacture a nanostructure.

901 Having step or means utilizing electromagnetic property (e.g., optical, x-ray, electron beam, etc.)
Subject matter under subclass 840 wherein the process or apparatus uses electromagnetic irradiation to manufacture a nanostructure.

(1) Note. The electromagnetic irradiation may be of the visible light range (i.e., optical) or may be in the form of x-rays or electron beams.

902 SPECIFIED USE OF NANOSTRUCTURE:
Subject matter under the class definition wherein a nanostructure is a component of a device or system or is used as part of a process with a particular function or purpose.

(1) Note. This subclass covers combination claims which includes a nanostructure as part of a subcombination wherein subclass this does not exit covers only the particular details of the nanostructure subcombination.

(2) Note. This subclass covers process of use claims that include nanostructures provided to accomplish a specified functional requirement.

903 For conversion, containment, or destruction of hazardous material:
Subject matter under subclass 902 wherein the nanostructure material aids in chemically altering, confining or degrading a substance that would be harmful to living organisms or habitats.

904 For medical, immunological, body treatment, or diagnosis:
Subject matter under subclass 902 wherein the nanostructure is used in a process or apparatus for medical evaluation or treatment of a condition of a living body or for prevention of a disease.

905 Specially adapted for travel through blood circulatory system:
Subject matter under subclass 904 wherein the use comprises a process or device for moving through the network for supplying blood in a body.

SEE OR SEARCH CLASS:

435, Molecular Biology and Microbiology, appropriate subclasses for cell culture, general molecular biology, etc.

436, Chemistry: Analytical and Immunological Testing, subclass 66 for blood testing.

424, Drug, Bio-affecting and Body Treating Compositions, subclasses 9.3-9.37 for in vivo diagnosis or in vivo testing.

514, Drug, Bio-affecting and Body Treating Compositions, appropriate subclasses for gene therapy, protein therapy, etc.

906 Drug delivery:
Subject matter under subclass 904 wherein the nanostructure is adapted for delivery of a therapeutic compound or composition to living organs, tissues, or cells.

907 Liposome:
Subject matter under subclass 906 wherein the nanostructure used for delivery of the therapeutic agent includes a liposome.

(1) Note. Liposomes are particles, the shells of which include a lipid bilayer.

908 Mechanical repair performed/surgical:
Subject matter under subclass 904 wherein the nanostructure is used for in *vivo or in vitro* repair of cells or tissue, e.g., in surgery, etc.

SEE OR SEARCH CLASS:

128, Surgery, appropriate subclasses for a surgical process.

600, Surgery, appropriate subclasses for a surgical process.

909 Obstruction removal:
Subject matter under subclass 908 wherein the nanostructure is used for removing obstruction, e.g., removal of plaque, etc.

910 Strengthening cell or tissue:
Subject matter under subclass 908 wherein the nanostructure is used for reinforcing the cells or tissue.

911 Cancer cell destruction:
Subject matter under subclass 908 wherein the nanostructure is used for killing/eliminating cancer cells or tissue.

912 Cancer cell repair:
Subject matter under subclass 908wherein the nanostructure is used for converting cancerous cells or tissue into normal cells or tissue.

913 Stem cell therapy implantation:
Subject matter under subclass 908 wherein the nanostructure is used for transplanting stem cells for treating a disease.

914 Protein engineering:
Subject matter under subclass 904 wherein the nanostructure is adapted for use in the synthesis of polypeptides.

SEE OR SEARCH CLASS:

530, Chemistry, Natural Resins or Derivatives; Peptides or Proteins; Lignins or Reaction Products Thereof, particularly subclasses 333-342 for synthesis of polypeptides.

915 Therapeutic or pharmaceutical composition:
Subject matter under subclass 904 comprising a chemical compound constructed to treat an affliction or a disease of a body.

SEE OR SEARCH CLASS:

424, Drug, Bio-Affecting and Body Treating Compositions, appropriate subclasses for a therapeutic composition, per se.

435, Chemistry: Molecular Biology and Microbiology, appropriate subclasses for plasmids, vectors, and cells comprising a vector.

514, Drug, Bio-Affecting and Body Treating Compositions, appropriate subclasses for a therapeutic composition, per se.

916 Gene therapy:
Subject matter under subclass 915 wherein the nanostructure is utilized for the insertion, deletion, addition, or substitution of a nucleotide or nucleotides in an already existing DNA sequence, e.g., gene, plasmid, cosmid, a viral or phage DNA, etc., wherein the DNA sequence is then used for treating a disease.

(1) Note. Examples of processes intended for this subclass include administering nucleic acid (DNA, RNA) into animals by intramuscular, intraperitoneal, intravenous, oral, or any other route.

SEE OR SEARCH THIS CLASS, SUBCLASS:

906, for nanostructure used for delivering a modified gene into living organs, tissue, or cells.

917 Vaccine:
Subject matter under subclass 915 wherein the nanostructure is part of an adjuvant adapted for producing an immunological response and vaccination against a disease or infection.

(1) Note. The nanostructure may increase the immunological response of a nucleic acid or protein delivered.

918 Immunological:
Subject matter under subclass 904 wherein a substance comprising a nanostructure is used to prevent a disease in a body.

SEE OR SEARCH CLASS:

424, Drug, Bio-Affecting and Body Treating Compositions, subclasses 130.1-177.1 for an immunoglobulin, antiserum, or antibody treating composition.

436, Chemistry: Analytical and Immunological Testing, for immunological analysis and testing.

919 Dental:
Subject matter under subclass 904 wherein the nanostructure is used in a process or device for treating teeth.

SEE OR SEARCH CLASS:

433, Dentistry, appropriate subclasses for a process and device for treating human teeth.

920 Detection of biochemical:
Subject matter under subclass 904 wherein the nanostructure is used for the detection of a biological chemical.

921 Of toxic chemical:
Subject matter under subclass 920 wherein the nanostructure is used for the detection of a toxic chemical or molecule.

922 Of explosive material:
Subject matter under subclass 920 wherein the nanostructure is used for the detection of an explosive material.

923 Cell culture:
Subject matter under subclass 904 wherein the nanostructure is adapted for providing a support surface for growing cells in culture.

SEE OR SEARCH CLASS:

435, Chemistry: Molecular Biology and Microbiology, subclasses 395-403 for solid supports and methods of culturing cells on solid supports.

924 Using nanostructure as support of DNA analysis:
Subject matter under subclass 904 wherein the nanostructure is adapted for providing a support surface in DNA analysis, e.g., DNA sequencing, etc.

925 Bioelectrical:
Subject matter under subclass 904 wherein the nanostrusture is used in an electrical process or device for treating a living organism.

SEE OR SEARCH CLASS:

607, Surgery: Light, Thermal, and Electrical Application, appropriate subclasses for a process of bioelectrically treating a human body.

926 Topical chemical (e.g., cosmetic or sunscreen, etc.):
Subject matter under subclass 904 wherein the nanostructure is used for exterior surface of the body.

927 Diagnostic contrast agent:
Subject matter under subclass 904 wherein a nanostructure is used in a diagnosis process or to enhance image differences between body tissues in the diagnosis process.

928 X-ray agent:
Subject matter under subclass 927 wherein the nanostructure is used as a contrast agent in the x-ray process.

929 Ultrasound contrast agent:
Subject matter under subclass 927 wherein the nanostructure is used as a contrast agent in an ultrasound process.

930 MRI contrast agent:
Subject matter under subclass 927 wherein the nanostructure is used as a contrast agent in an MRI process.

SEE OR SEARCH CLASS:

424, Drug, Bio-Affecting and Body Treating Compositions, subclass 9.3 for chemical compound or compositions used as contrast agents in magnetic imaging devices.

600, Surgery, subclass 407 for nuclear, electromagnetic, or ultrasonic diagnostic devices using diagnostic contrast agents.

931 Medical device coating:
Subject matter under subclass 904 wherein the nanostructure is used to layer a medical implement.

932 For electronic or optoelectronic` application:
Subject matter under subclass 902 wherein a nanostructure is used in an electronic or optoelectronic device or process.

(1) Note. This subclass and those indented below are primarily intended for electronic or optoelectronic devices and applications employing fullerenes, i.e., buckyballs, nanotubes; quantum confinement structures, i.e., quantum dots, quantum wires; molecular, or atomic structures as significant components of the electronic or optoelectronic devices.

(2) Note. Solid-state semiconductor based circuits or circuit components, e.g., MOSFETS, etc., which recite dimensions of nanometer scale is insufficient for placement herein.

933 Spintronics or quantum computing:
Subject matter under subclass 932 wherein the device or process uses electron-spin or nuclear-spin properties to perform functions or to process information.

(1) Note. The term "spintronics" is also referred to as spin electronics, magnetoelectronics, or quantum computing.

(2) Note. There are of two stable spins (up and down). Electron spin causes magnetism on the atomic level.

934 Giant magnetoresistance (GMR):
Subject matter under subclass 933 wherein the spintronic device exhibits or produces a large change in electrical resistance upon application of an external magnetic field (i.e., GMR) effect.

(1) Note. "Giant" refers to the very large electrical signal of a GMR device.

(2) Note. GMR devices are widely used to sense magnetic field, as read-head sensors in hard disk drives, and magnetic random access memory.

SEE OR SEARCH CLASS:

324, Electricity: Measuring and Testing, appropriate subclasses for measuring magnetic property.

360, Dynamic Magnetic Information Storage or Retrieval, subclasses 313-327.33 for magnetoresistance heads.

935 Spin dependent tunnel (SDT) junction (e.g., tunnelling magnetoresistance (TMR), etc.):
Subject matter under subclass 933 wherein the spintronic device exhibits or produces a large change in resistance through a normally insulating layer, depending on the predominant electron spin in a free layer.

936 In a transistor or 3-terminal device:
Subject matter under subclass 932 wherein the nanostructure is used in a semiconductor device having three electrodes or terminals.

937 Single electron transistor:
Subject matter under subclass 936 wherein the nanostructure is used in a three terminal switching device that can transfer electrons individually.

938 Field Effect transistors (FETs) with nanowire- or nanotube-channel region:
Subject matter under subclass 936 wherein the nanostructure such as a nanowire or a nanotube is used in the conductive path, i.e. channel region, between the drain and the source terminals of the transistor.

939 Electron emitter (e.g., Spindt emitter tip coated with nanoparticles, etc.):
Subject matter under subclass 936 wherein the nanostructure is used to produce cathode components in field emission devices such as electron discharge tubes.

SEE OR SEARCH CLASS:

313, Electric Lamp and Discharge Devices, appropriate subclasses for electron generators.

940 In a logic circuit:
Subject matter under subclass 932 wherein the nanostructure is used in an electronic circuit that performs combinational or sequential digital logic functions.

(1) Note. Included herein are circuits having nanostructures that used for Boolean operations to form counters, shift registers, or other devices used in digital computation.

SEE OR SEARCH CLASS:

326, Electronic Digital Logic Circuitry, subclasses 37-50 for combinational or sequential logic.

941 Including DNA logic element:
Subject matter under subclass 940 wherein the nanostructure in the logic circuit is a nucleic acid, e.g., DNA molecule, etc.

942 Including Protein logic element:
Subject matter under subclass 940 wherein the nanostructure in the logic circuit is a protein.

943 Information storage or retrieval using nanostructure:
Subject matter under subclass 932 wherein the nanostructure is used for storing or retrieving information.

SEE OR SEARCH CLASS:

360, Dynamic Magnetic Information Storage or Retrieval, subclasses 313 and 328 for magnetostrictive head.

365, Static Information Storage or Retrieval, subclasses 129-150 for information storage or retrieval devices including particular elements for writing and reading of static information, subclass 151 for information storage on the molecular or atomic level.

369, Dynamic Information Storage or Retrieval, subclasses 271.1-291.1 for storage medium structure.

944 Biochemical memory:
Subject matter under subclass 943 wherein the information storage or retrieval is a biochemical molecule.

945 Protein memory:
Subject matter under subclass 944 wherein the information storage or retrieval is a protein.

946 Nucleic acid memory:
Subject matter under subclass 944 wherein the information storage or retrieval is a nucleic acid.

947 With scanning probe instrument:
Subject matter under 943 wherein a nanosized tip is used to perform the information storage or retrieval, e.g. nanosized tip is used to read or write information data, etc.

SEE OR SEARCH THIS CLASS, SUBCLASS:

849 -879, for scanning probes used in the manufacture, treatment, or detection of nanostructures.

948 Energy storage/generating using nanostructure (e.g., fuel cell, battery, etc.):
Subject matter under subclass 932 wherein the nanostructure facilitates the storage or generation of energy such as in a capacitor or battery fuel cell.

SEE OR SEARCH CLASS:

60, Power Plants, appropriate subclasses for energy conversion to produce power.

136, Batteries: Thermoelectric and Photoelectric, subclasses 200-242 for thermoelectric batteries, and 243- 265 for photoelectric batteries.

429, Chemistry: Electrical Current Producing Apparatus, Product, and Process, for electrochemical batteries, and particularly subclasses 12-46 for fuel cells.

949 Radiation emitter using nanostructure:
Subject matter under subclass 932 wherein the nanostructure is used to convert electric energy into emitting radiant energy.

SEE OR SEARCH CLASS:

250, Radiant Energy, appropriate subclasses for methods and apparatus for generating radiant energy.

950 Electromagnetic energy:
Subject matter under subclass 949 wherein the radiant energy is electromagnetic energy, i.e., radio, microwave, infrared, visible light, ultraviolet, x-ray, gamma ray.

951 Laser:
Subject matter under subclass 950 wherein the electromagnetic energy is a coherent, directional beam of light generated by stimulating electronic, ionic, or molecular transitions to lower energy levels.

SEE OR SEARCH CLASS:

372, Coherent Light Generators, subclasses 1-3, 5-8, and 38.1-38.09 for laser generators.

952 Display:
Subject matter under subclass 932 wherein the nanostructure is used to convert electric signal into images in visual form such as a cathode ray tube, LCD, or LED display.

(1) Note. This subclass includes nanostructure and refers to more than simply the molecules found in the cell structure of liquid crystals.

SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclasses 10-111 for displays.

349, Liquid Crystal Cells, Elements and System, subclasses 1-18 for particular liquid crystal system.

953 Detector using nanostructure:
Subject matter under subclass 932 wherein the device includes a nanostructure to convert a form of a measurement into an electrical signal.

954 Of radiant energy:
Subject matter under subclass 953 wherein the measurement is of radiation, e.g., electromagnetic waves, electrons, etc.

SEE OR SEARCH CLASS:

250, Radiant Energy, subclasses 251, 253-266, and 306-311 for method or apparatus for detecting radiant energy.

955 Of thermal property:
Subject matter under subclass 953 wherein the measurement is thermal in nature, e.g., heat, temperature, cooling rate, etc.

SEE OR SEARCH CLASS:

374, Thermal Measuring and Testing, appropriate subclasses for methods and apparatus for detecting thermal properties.

956 Of mechanical property:
Subject matter under subclass 953 wherein the measurement is mechanical in nature, i.e., strain, stress, pressure, flow rate, size.

SEE OR SEARCH CLASS:

73, Measuring and Testing, appropriate subclasses for methods and apparatus for detecting mechanical properties.

957 Of chemical property or presence:
Subject matter under subclass 953 wherein the measurement is chemical in nature (i.e., pH, electrochemical, DNA sequencing, etc.).

SEE OR SEARCH CLASS:

436, Chemistry: Analytical and Immunological Testing, appropriate subclasses for methods and apparatus for detecting chemical properties.

702, Data Processing: Measuring, Calibrating, or Testing, subclasses 19-21 for methods and apparatus utilizing a data processing system in a measurement system directed to an environment of life or chemical compound or process in a living system.

958 Of biomolecule property:
Subject matter under subclass 957 wherein the measured property is relating to a living organism.

959 Of disease state:
Subject matter under subclass 958 wherein the measured property is a form of a disease.

960 Of magnetic property:
Subject matter under subclass 953 wherein the measurement is magnetic in nature, e.g., magnetic field strength, magnetic hysteresis, magnetoresistance, etc.

961 For textile or fabric treatment:
Subject matter under subclass 902 wherein the nanostructure is used for altering a condition of a fabric.

SEE OR SEARCH CLASS:

8, Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers, appropriate subclasses for chemical treatment of a textile.

26, Textiles: Cloth Finishing, appropriate subclasses for finishing of a textile.

442, Fabric (Woven, Knitted, or Nonwoven Textile or Cloth, etc.), appropriate subclasses for a textile or fabric, per se.

962 For carrying or transporting:
Subject matter under subclass 902 wherein the nanotructure is used for moving or conveying an article.

SEE OR SEARCH CLASS:

187, Elevator, Industrial Lift Truck, or Stationary Lift For Vehicle, appropriate subclasses for an apparatus for vertically moving an article.

198, Conveyors: Power-Driven, appropriate subclasses for powered conveyors.

224, Package and Article Carriers, appropriate subclasses for an apparatus for carrying an article.

414, Material or Article Handling, appropriate subclasses for an apparatus or method of handling an article.

963 MISCELLANEOUS:
Subject matter under the class definition wherein the nanostructure includes details not otherwise provided for in this schedule.