

G01Q

SCANNING-PROBE TECHNIQUES OR APPARATUS; APPLICATIONS OF SCANNING-PROBE TECHNIQUES, e.g. SCANNING PROBE MICROSCOPY [SPM]

Definition statement

This place covers:

Scanning probes, i.e. devices having at least a tip of nanometre sized dimensions that scans or moves over an object surface, typically at a distance of a few angstroms or nanometres, monitoring some interaction between the tip and the surface, e.g. monitoring the generation of a tunnelling current.

Techniques or apparatus involving the use of scanning probes.

The following subjects are therefore covered, the list being non-exhaustive:

- scanning probes per se, their manufacture or their related instrumentation, e.g. holders.
- scanning-probe microscopy (SPM) or microscopes, i.e. the application of scanning probes to the investigation or analysis of a surface structure in atomic ranges.
- applications, other than SPM, involving the use of scanning probes.

References

Limiting references

This place does not cover:

Electron or ion microscopes (e.g. scanning electron microscopes, transmission electron microscopes) and details thereof	H01J 37/00
---	----------------------------

Informative references

Attention is drawn to the following places, which may be of interest for search:

Optical microscopes in general	G02B 21/00
--------------------------------	----------------------------

Special rules of classification

In this subclass, the first place priority rule is applied, i.e. at each hierarchical level, classification is made in the first appropriate place.

G01Q 10/00

Scanning or positioning arrangements, i.e. arrangements for actively controlling the movement or position of the probe

Definition statement

This place covers:

Actively controlling the movement or the location of the scanning probe tip relative to the object surface.

G01Q 10/02**Coarse scanning or positioning****Definition statement**

This place covers:

Generating movement of the scanning probe tip relative to the object surface at a scale larger than the resolution of the scanning probe microscope.

Coarse scanning or positioning means are at least partially mechanical.

Illustrative example: US6267005

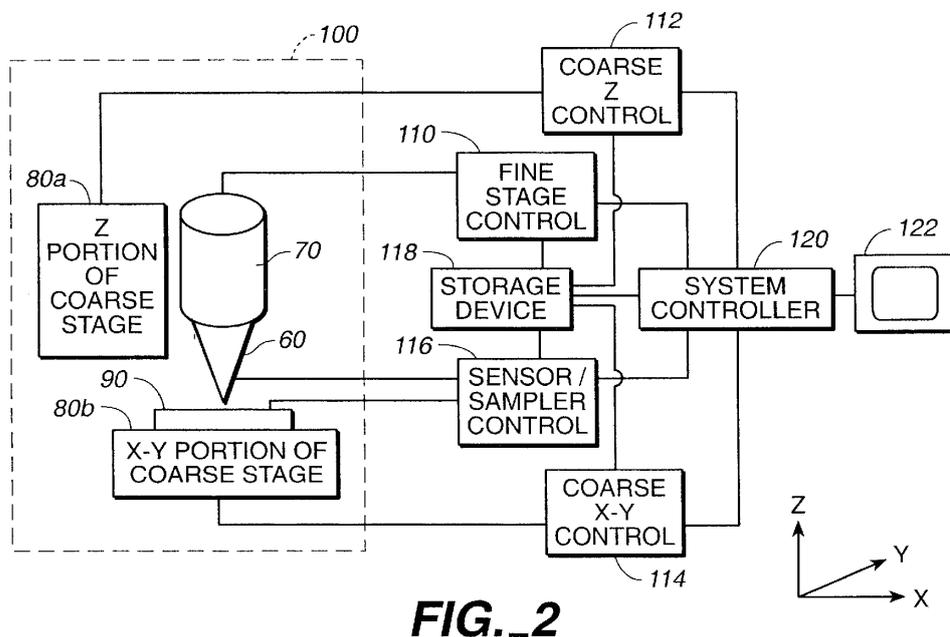


FIG. 2

G01Q 10/04**Fine scanning or positioning****Definition statement**

This place covers:

Generating movement of the scanning probe tip relative to the object surface of a size comparable to the resolution of the scanning probe microscope.

Fine scanning. Piezoelectrical scanning or positioning means are classified in this group.

Illustrative example:

Patent Application Publication Jul. 12, 2007 Sheet 1 of 6 US 2007/0158559 A1

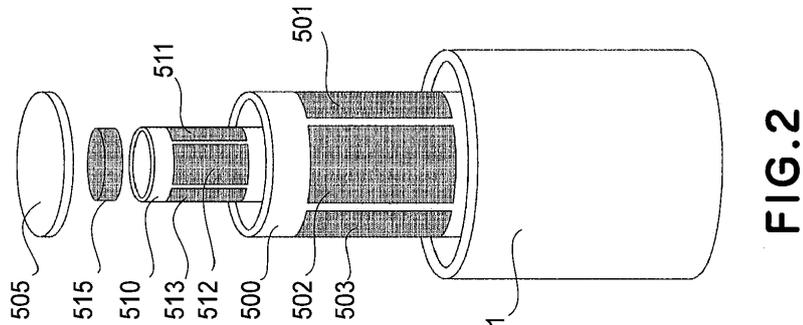


FIG.2

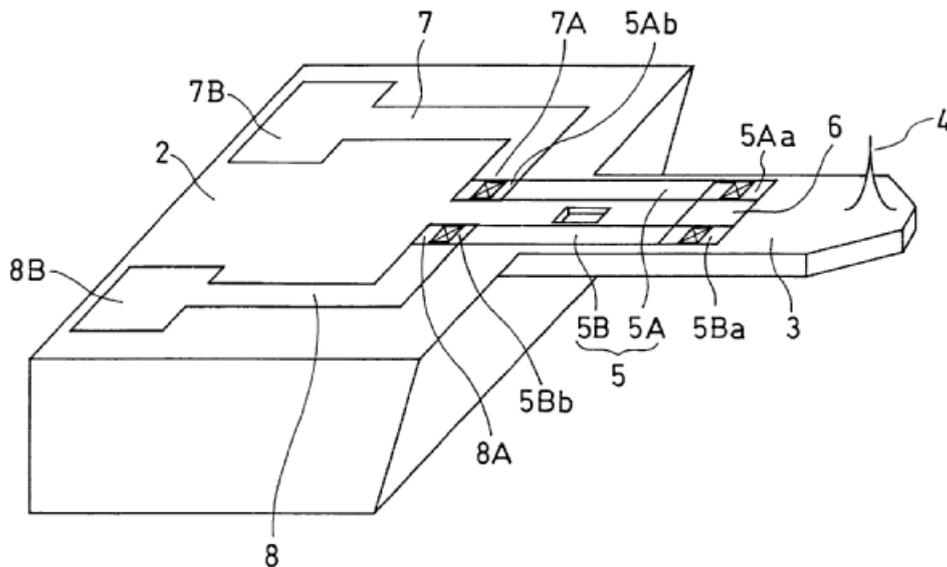
G01Q 10/045

{Self-actuating probes, i.e. wherein the actuating means for driving are part of the probe itself, e.g. piezoelectric means on a cantilever probe}

Definition statement

This place covers:

Illustrative example of subject matter classified in this group: US6422069.



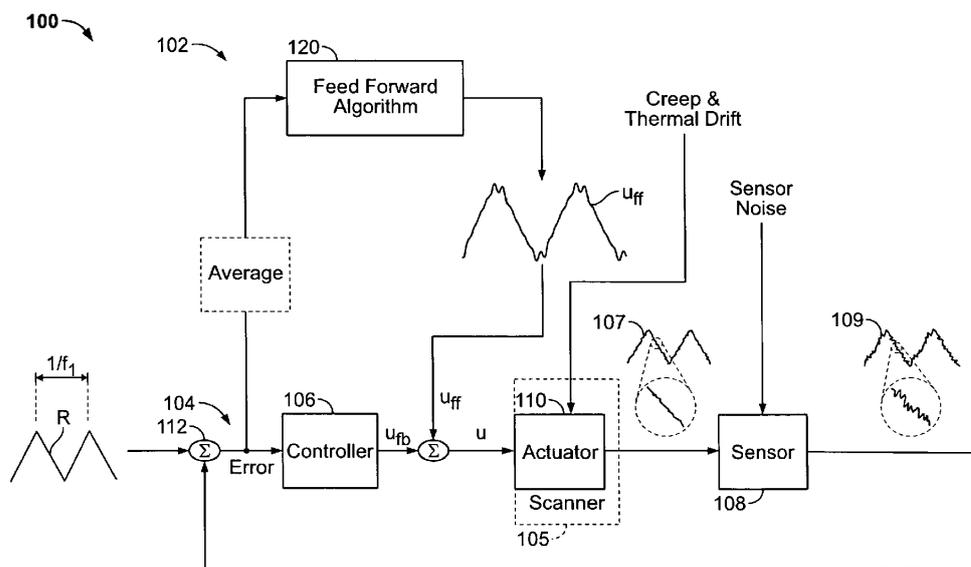
G01Q 10/06**Circuits or algorithms therefor****Definition statement**

This place covers:

Electronic means for locating or stabilizing the movement of the scanning probe tip relative to the object surface.

Electronic circuits or algorithms governing scanning.

Illustrative example: US2008/0277582, Figure 6.

**G01Q 10/065**

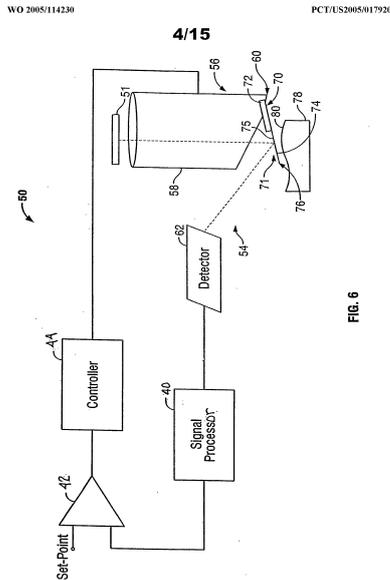
{Feedback mechanisms, i.e. wherein the signal for driving the probe is modified by a signal coming from the probe itself}

Definition statement

This place covers:

Circuits or algorithms for driving the scanning probe during a scanning probe microscopy measurement, wherein the driving signal is adjusted during the measurement by using the detected signal coming from the interaction between the probe and the sample.

Illustrative example:



Special rules of classification

In the case said circuits or algorithms belong to a specific kind of scanning probe microscope, the documents about them should be classified in the class pertinent to said particular kind of scanning probe microscope: e.g. a tapping mode atomic force microscopy, wherein the detected signal is used to keep the oscillation frequency of an atomic force microscopy probe, i.e., a cantilever, at its resonance frequency, should be classified in [G01Q 60/34](#).

G01Q 20/00

Monitoring the movement or position of the probe

Definition statement

This place covers:

Methods or apparatus to monitor the movement of the probe.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

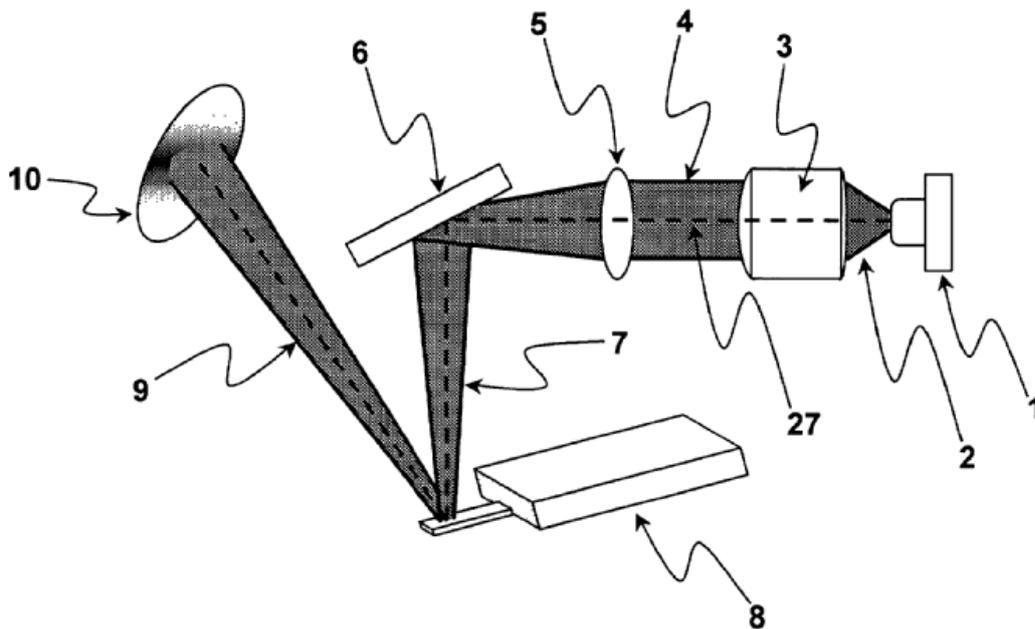
Monitoring the movement or position of the probe with active control thereof	G01Q 10/00
--	----------------------------

G01Q 20/02**by optical means****Definition statement**

This place covers:

Monitoring the movement of the probe by means of light-sensitive/responsive devices.

Illustrative example: US2003047675.

**G01Q 20/04****Self-detecting probes, i.e. wherein the probe itself generates a signal representative of its position, e.g. piezo-electric gauge****Definition statement**

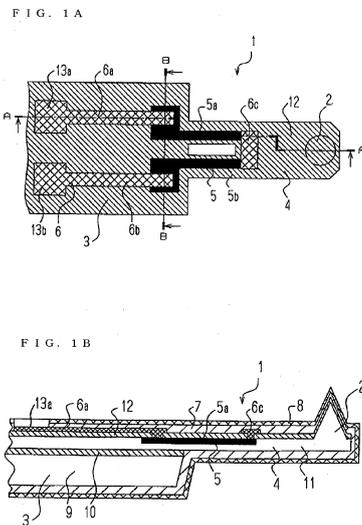
This place covers:

Probes comprising in their structure means for detecting a signal to control/monitor their movements, e.g. piezoelectric gauges.

This group covers any kind of position-sensitive sensor integrated in the probe, like piezoresistive, capacitive, etc.

Illustrative example:

Patent Application Publication May 27, 2010 Sheet 1 of 10 US 2010/0132075 A1



G01Q 30/00

Auxiliary means serving to assist or improve the scanning probe techniques or apparatus, e.g. display or data processing devices

Definition statement

This place covers:

Devices or methods to assist or improve the analysis or investigation.

G01Q 30/02

Non-SPM analysing devices, e.g. SEM [Scanning Electron Microscope], spectrometer or optical microscope

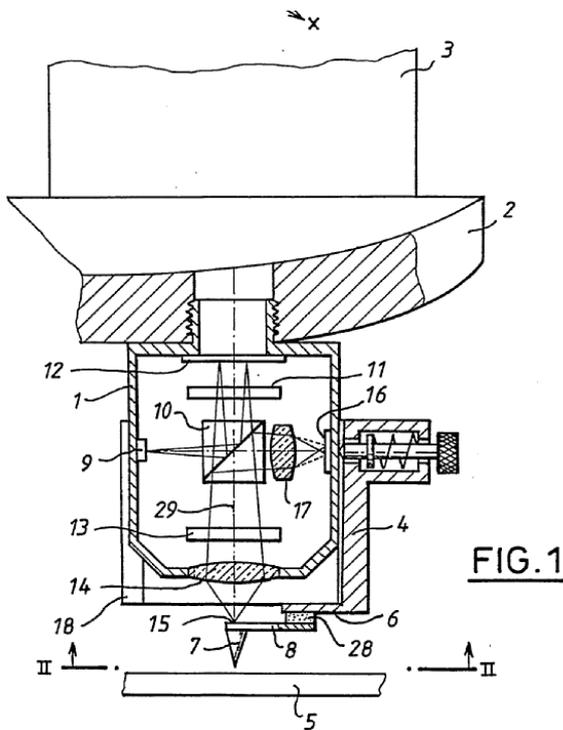
Definition statement

This place covers:

An analysing or investigating device, different from a scanning probe microscope, for assisting or improving the master scanning probe techniques or apparatus.

G01Q 30/025**{Optical microscopes coupled with SPM}****Definition statement***This place covers:*

Illustrative example of subject matter classified in this group: DE4233399.

**G01Q 30/04****Display or data processing devices****Definition statement***This place covers:*

A programmable device that stores, retrieves, processes or displays data for assisting or improving the scanning probe techniques or apparatus.

This subgroup covers computers, other programmable devices, mathematical models and mathematical methods and algorithms for data analysis.

Illustrative example:

Patent Application Publication Oct. 28, 2004 Sheet 2 of 11 US 2004/0213443 A1

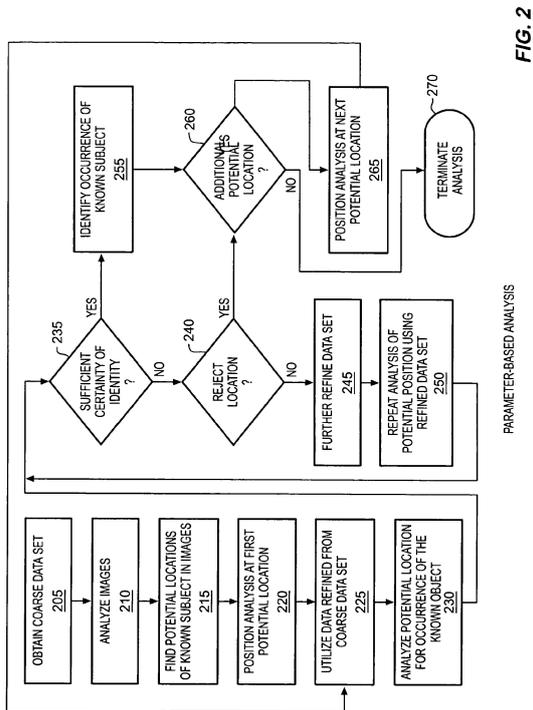


FIG. 2

G01Q 30/06

for error compensation

Definition statement

This place covers:

A programmable device wherein the data information is used to correct or fix the performance of the SPM.

Illustrative example:

Patent Application Publication Nov. 1, 2007 Sheet 9 of 10 US 2007/0251306 A1

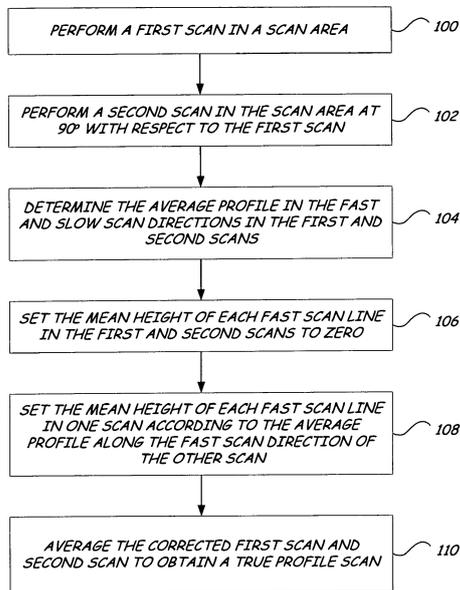


FIG. 6

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Feedback methods	G01Q 10/065
Regulations/error compensation means integrated in the probe	G01Q 70/04

G01Q 30/08

Means for establishing or regulating a desired environmental condition within a sample chamber

Definition statement

This place covers:

Means to adjust or control parameters, e.g. temperature, pressure or humidity, of a working environment condition inside the chamber containing the sample being studied.

G01Q 30/10

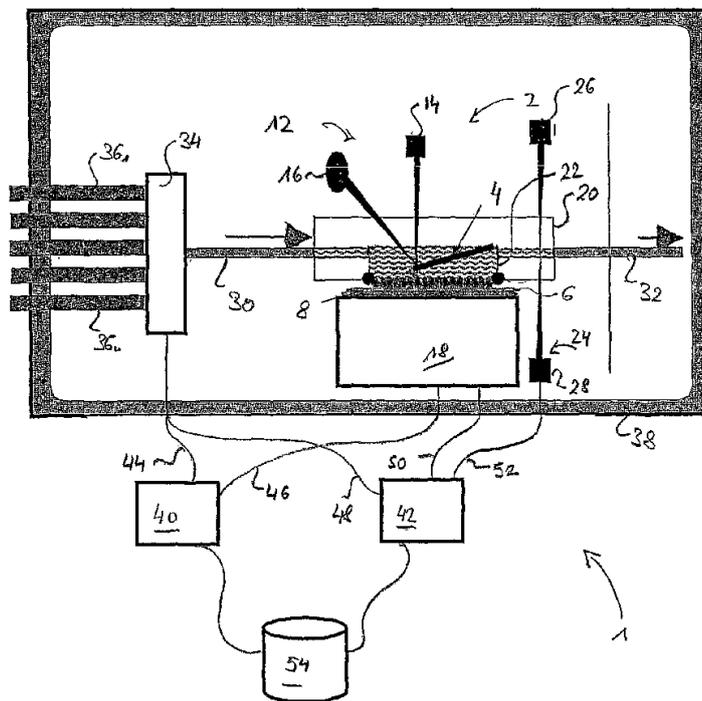
Thermal environment

Definition statement

This place covers:

Means to adjust or control the temperature of the sample chamber, e.g. a cryostat or heater that allows SPM to be performed at low or high temperatures.

Illustrative example: WO2006/040025, Figure 2



G01Q 30/14

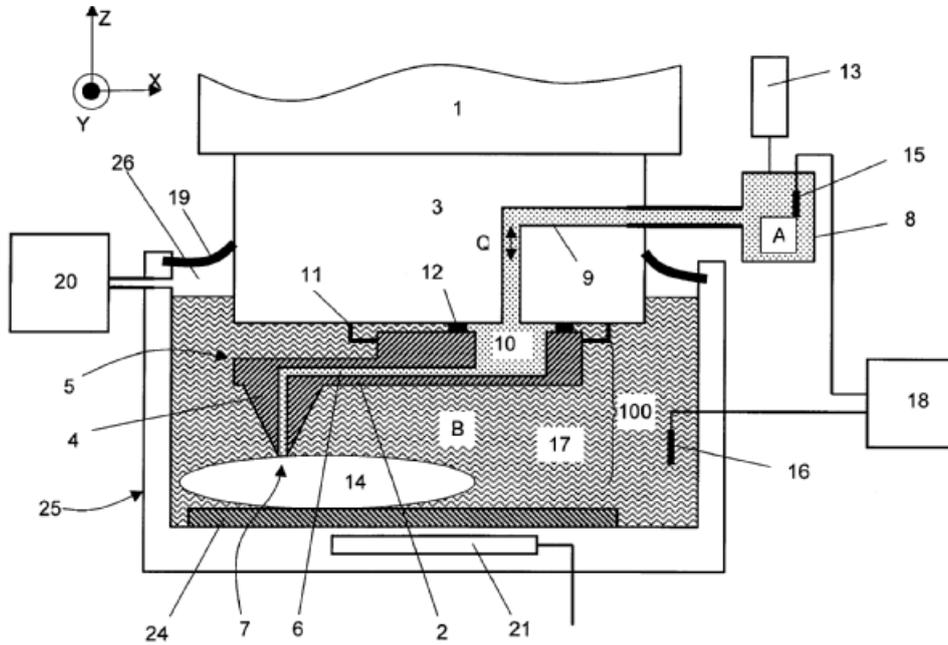
Liquid environment

Definition statement

This place covers:

Means to adjust or control parameters of the liquid environment, e.g. water or other liquid chemical, inside the sample chamber.

Illustrative example: EP1990626



G01Q 30/16

Vacuum environment

Definition statement

This place covers:

Means to adjust or control a vacuum condition inside the sample chamber, e.g. pumping means.

Illustrative example:

U.S. Patent Apr. 8, 1997 Sheet 2 of 12 5,619,035

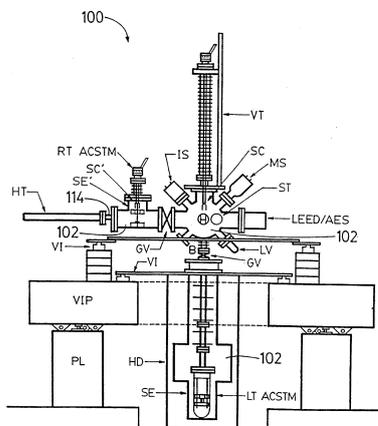


FIG. 2.

G01Q 30/18

Means for protecting or isolating the interior of a sample chamber from external environmental conditions or influences, e.g. vibrations or electromagnetic fields

Definition statement

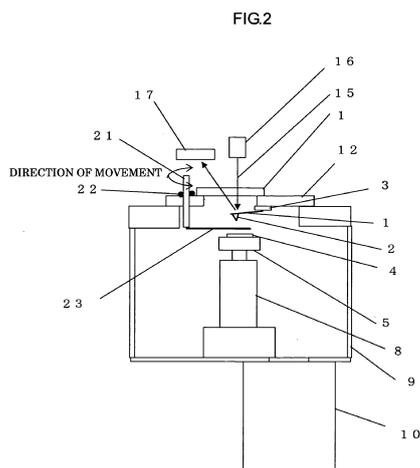
This place covers:

Means to prevent SPM from being disturbed by a condition outside the scanning probe microscope, e.g. vibration, temperature or pressure.

The SPM is protected as a whole under the adverse condition. For example, a specific housing or arrangement to eliminate external vibrations to assure the stability of the microscope, or shielding that protects it from electromagnetic fields.

Illustrative example:

Patent Application Publication Sep. 1, 2005 Sheet 2 of 4 US 2005/0189490 A1

**References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Environmental regulation means for sample chamber	G01Q 30/08
Regulations/error compensation means integrated in the probe	G01Q 70/04

G01Q 30/20**Sample handling devices or methods****Definition statement**

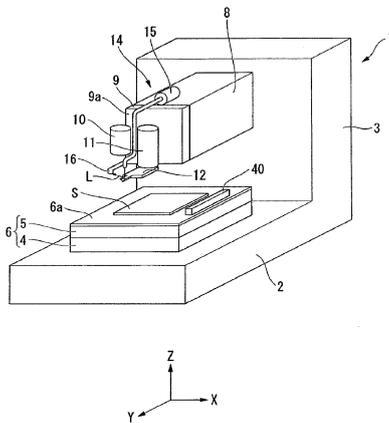
This place covers:

Methods or devices to perform mechanical operations on a sample in the scanning probe microscope for analysis or investigation, e.g. tweezers, cutting means.

Illustrative example:

Patent Application Publication Jul. 23, 2009 Sheet 1 of 12 US 2009/0188011 A1

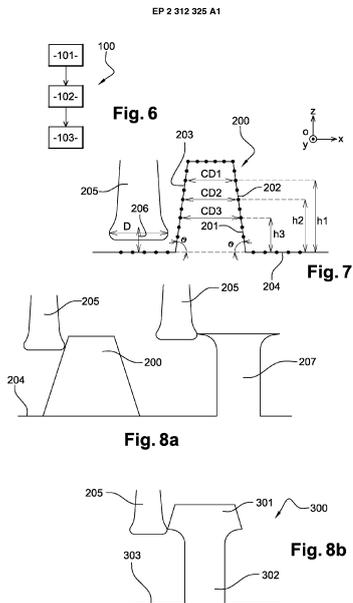
FIG. 1

**G01Q 40/00****Calibration, e.g. of probes****Definition statement**

This place covers:

Methods or apparatus used to adjust or rectify a SPM device, e.g. the probe itself, to a desired standard.

Illustrative example:



13

G01Q 40/02

Calibration standards and methods of fabrication thereof

Definition statement

This place covers:

Structure with nanometric resolution used for correcting or fixing the performance of the SPM device before its utilization, e.g. grating with a known line separation, and related manufacture.

Illustrative example: EP676614

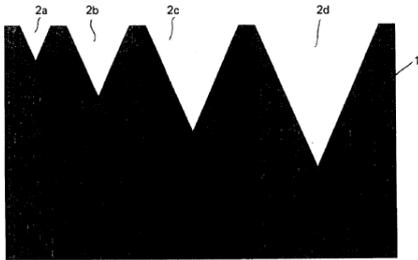


FIG. 2

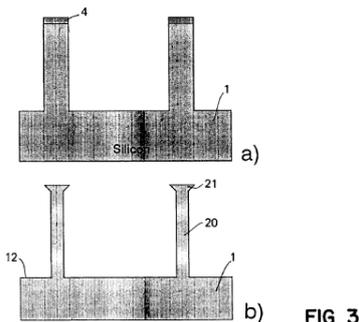


FIG. 3

G01Q 60/00

Particular types of SPM [Scanning Probe Microscopy] or microscopes; Essential components thereof

Definition statement

This place covers:

Methods or apparatus for which the type of interaction between the scanning probe tip and the sample surface is specified.

G01Q 60/02

Multiple-type SPM, i.e. involving more than one SPM techniques

Definition statement

This place covers:

Methods or apparatus involving two or more different types of interactions between the scanning probe tip and the sample surface, e.g. cantilever-type SPMs other than AFM which are explicitly built for AFM performances.

The device can contain either one probe or more than one probe to perform different types of SPM over the sample.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Devices containing array of tips with similar performance function	G01Q 70/06
--	----------------------------

G01Q 60/04**STM [Scanning Tunnelling Microscopy] combined with AFM [Atomic Force Microscopy]****Definition statement**

This place covers:

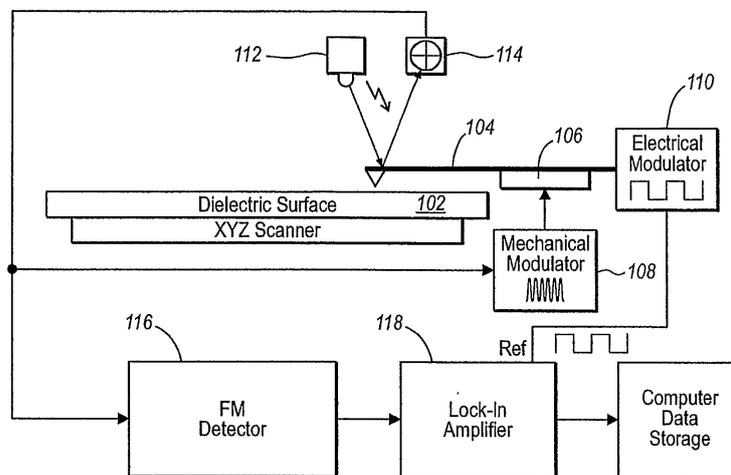
Methods or apparatus wherein the two monitored interactions are tunnelling current (STM) and the attractive or repulsive force between the probe and the sample surface (AFM).

Illustrative example:

WO 2006/102248

1/5

PCT/US2006/010074

**FIG. 1****References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Specific STMs	G01Q 60/10
Specific AFMs	G01Q 60/24

G01Q 60/06**SNOM [Scanning Near-field Optical Microscopy] combined with AFM [Atomic Force Microscopy]****Definition statement**

This place covers:

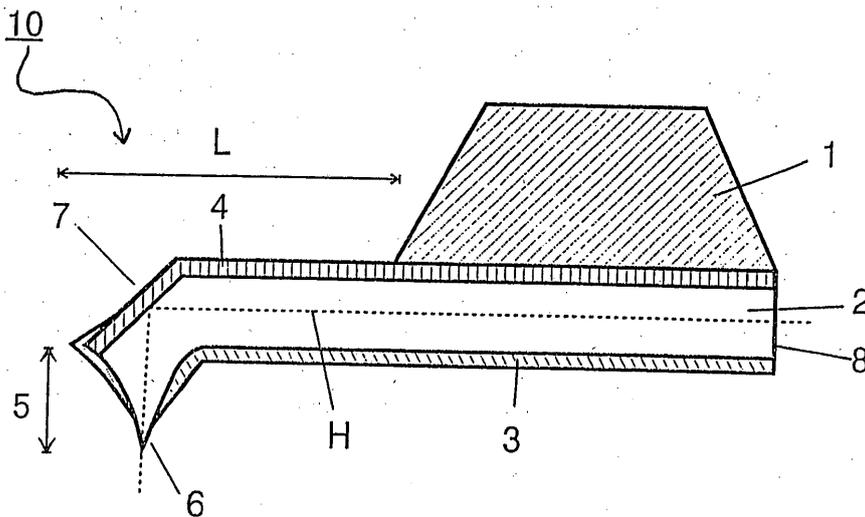
Methods or apparatus wherein the two monitored interactions are near-field light emitted from the sample surface (SNOM) and the attractive or repulsive force between the probe and the sample surface (AFM).

Illustrative example:

Patent Application Publication Sep. 13, 2007 Sheet 1 of 26

US 2007/0211986 A1

FIG. 1

**References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Specific SNOMs	G01Q 60/18
Specific AFMs	G01Q 60/24

G01Q 60/08

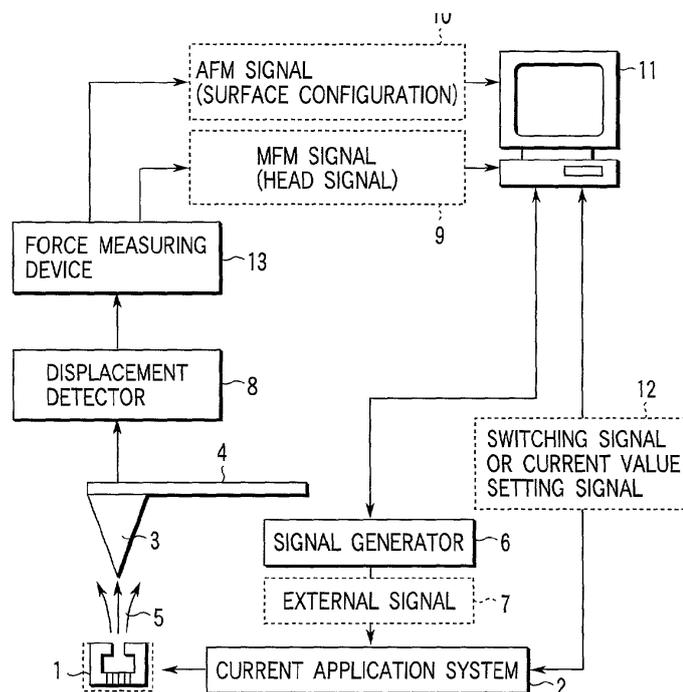
MFM [Magnetic Force Microscopy] combined with AFM [Atomic Force Microscopy]

Definition statement

This place covers:

Methods or apparatus wherein the two monitored interactions are the magnetic force between the sample and the probe (MFM) and the attractive or repulsive force between the probe and the sample surface (AFM).

Illustrative example: US2001/0030536, Figure 2



References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Specific AFMs	G01Q 60/24
Specific MFMs	G01Q 60/50

G01Q 60/10

STM [Scanning Tunnelling Microscopy] or apparatus therefor, e.g. STM probes

Definition statement

This place covers:

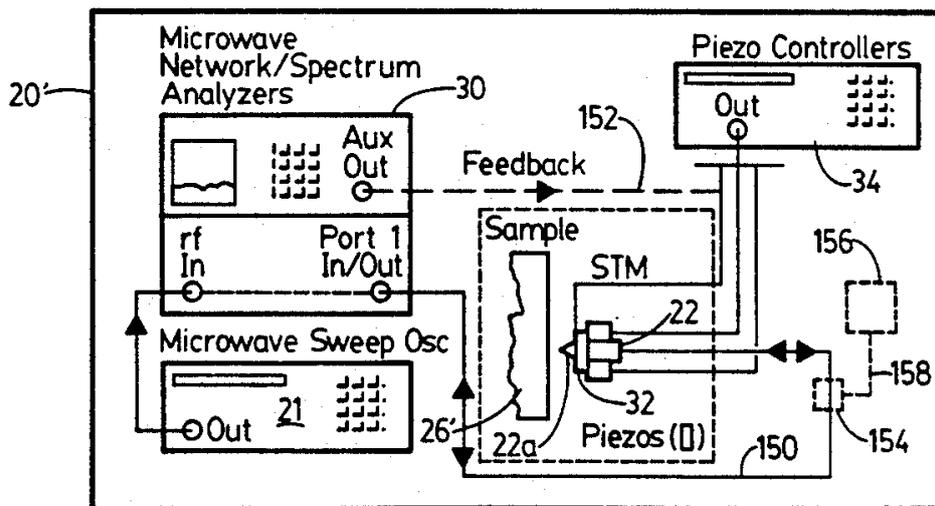
Methods or apparatus for SPM wherein the monitored interaction is the tunnelling current between the tip and the sample, which are in very close proximity but not actually in physical contact.

G01Q 60/12**STS [Scanning Tunnelling Spectroscopy]****Definition statement**

This place covers:

STM or apparatus therefor wherein the local electronic state of surface is analysed or investigated.

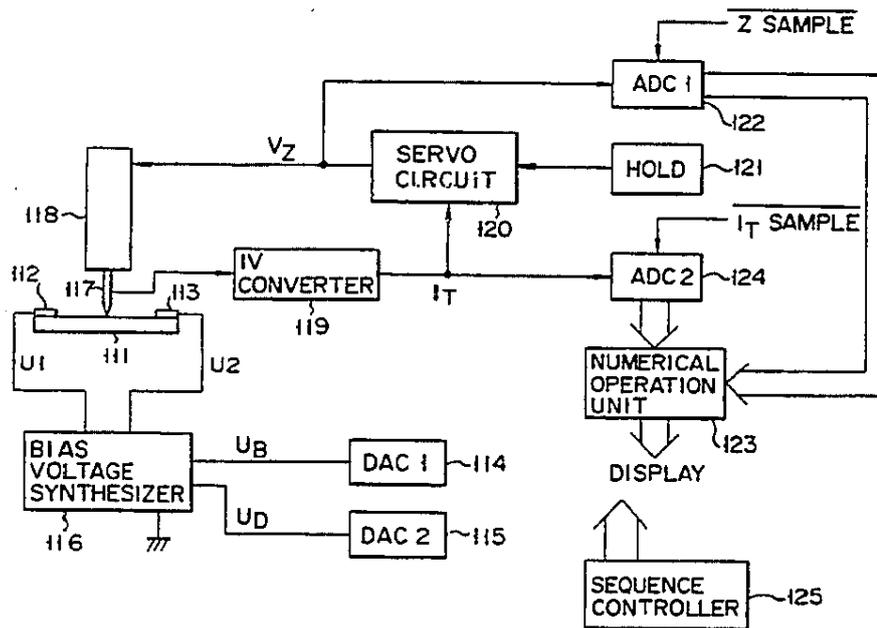
Illustrative example: US52881814

**G01Q 60/14****STP [Scanning Tunnelling Potentiometry]****Definition statement**

This place covers:

STM or apparatus therefor wherein the electric potential distribution on the sample is analysed or investigated.

Illustrative example: US5378983



G01Q 60/16

Probes, their manufacture, or their related instrumentation, e.g. holders

Definition statement

This place covers:

STM probes, their manufacture, or related instrumentation, e.g. holders.

Illustrative example: WO2010/086759

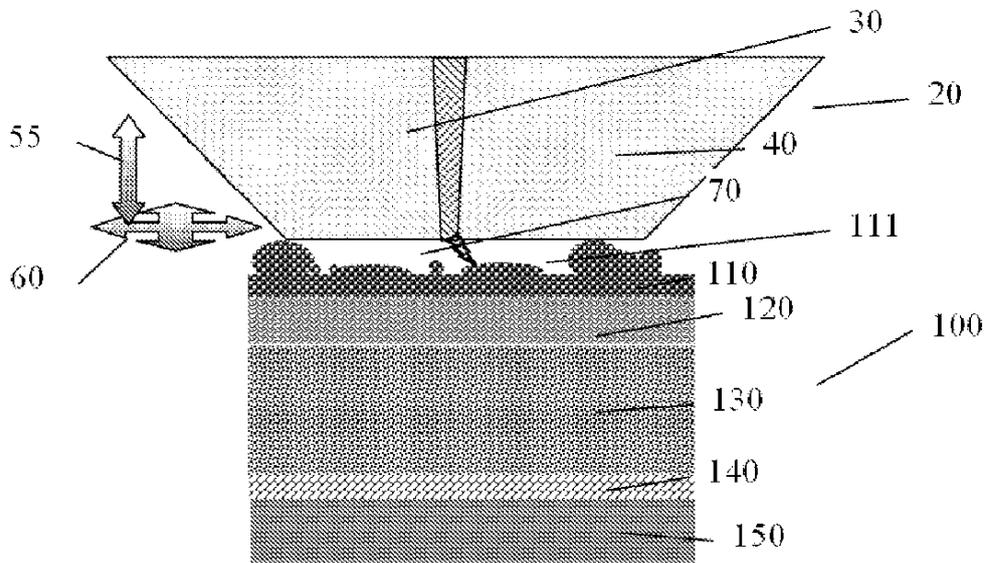


FIG. 2.

G01Q 60/18

SNOM [Scanning Near-Field Optical Microscopy] or apparatus therefor, e.g. SNOM probes

Definition statement

This place covers:

Methods or apparatus for SPM wherein the monitored interaction is the near-field light emitted or reflected from the object surface.

G01Q 60/20

Fluorescence

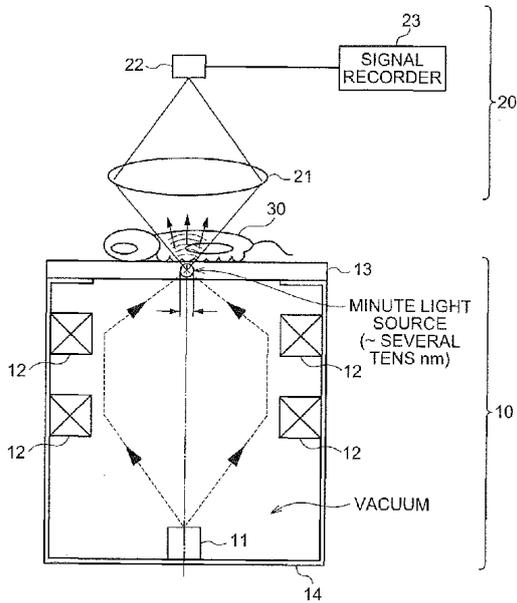
Definition statement

This place covers:

SNOM or apparatus therefor wherein the near-field light to be monitored is the emission radiation from a sample surface excited by an electromagnetic wave.

Illustrative example: EP2296027

FIG. 3



G01Q 60/22

Probes, their manufacture, or their related instrumentation, e.g. holders

Definition statement

This place covers:

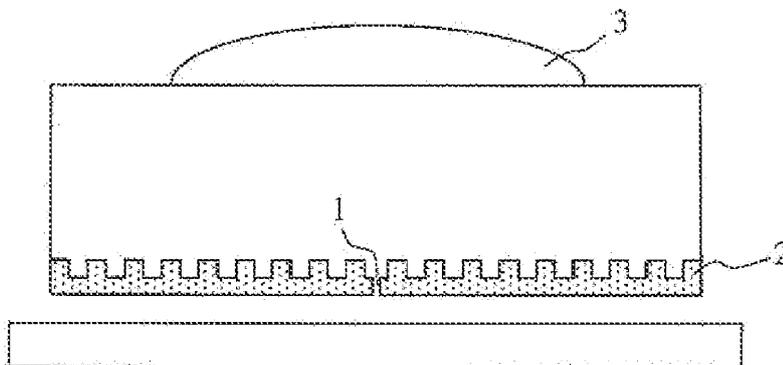
SNOM probes, their manufacture or related instrumentation, e.g. holders.

Illustrative example:

Patent Application Publication

Mar. 17, 2011 Sheet 1 of 7

US 2011/0063717 A1



G01Q 60/24**AFM [Atomic Force Microscopy] or apparatus therefor, e.g. AFM probes****Definition statement**

This place covers:

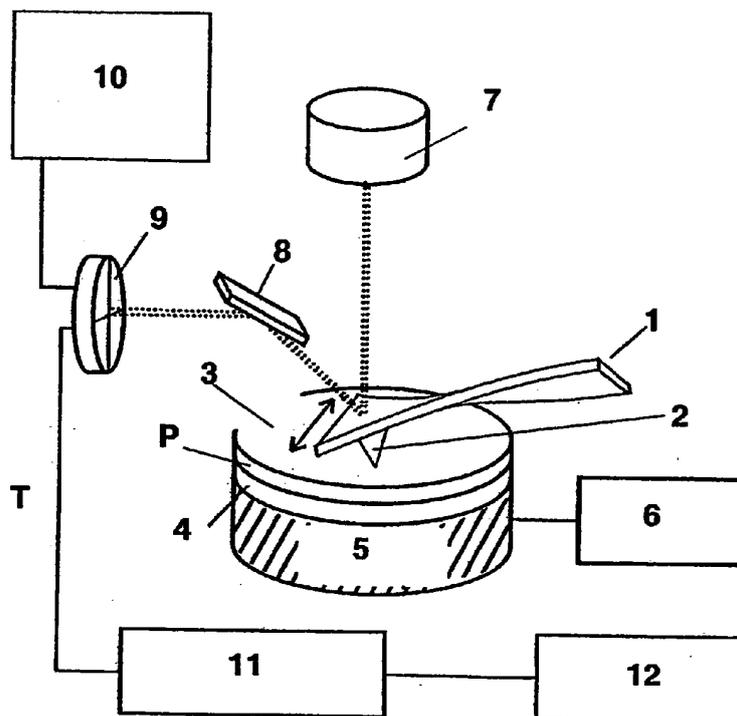
Methods or apparatus for SPM wherein the monitored interaction is the short range repulsive or long range attractive force between the probe and atoms of the sample surface.

G01Q 60/26**Friction force microscopy****Definition statement**

This place covers:

AFM or apparatus therefor wherein the force monitored is the shear force between the probe and atoms of the sample surface.

Illustrative example: US2006/0150719

**G01Q 60/28****Adhesion force microscopy****Definition statement**

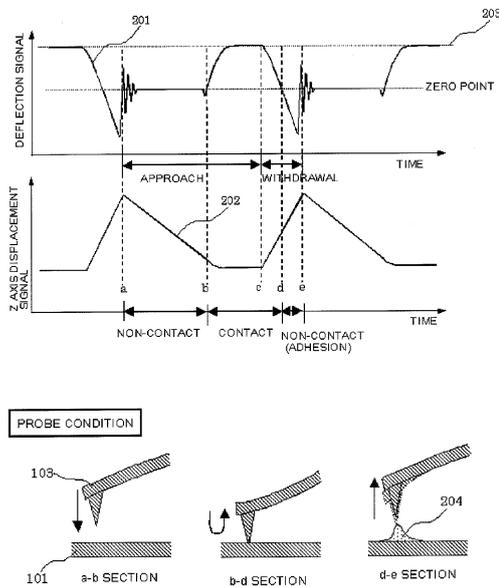
This place covers:

AFM or apparatus therefor wherein the force monitored is the adhesion force that tends to keep the probe in contact with the sample surface.

Illustrative example:

Patent Application Publication Nov. 22, 2007 Sheet 2 of 16 US 2007/0266780 A1

FIG. 2



G01Q 60/30

Scanning potential microscopy

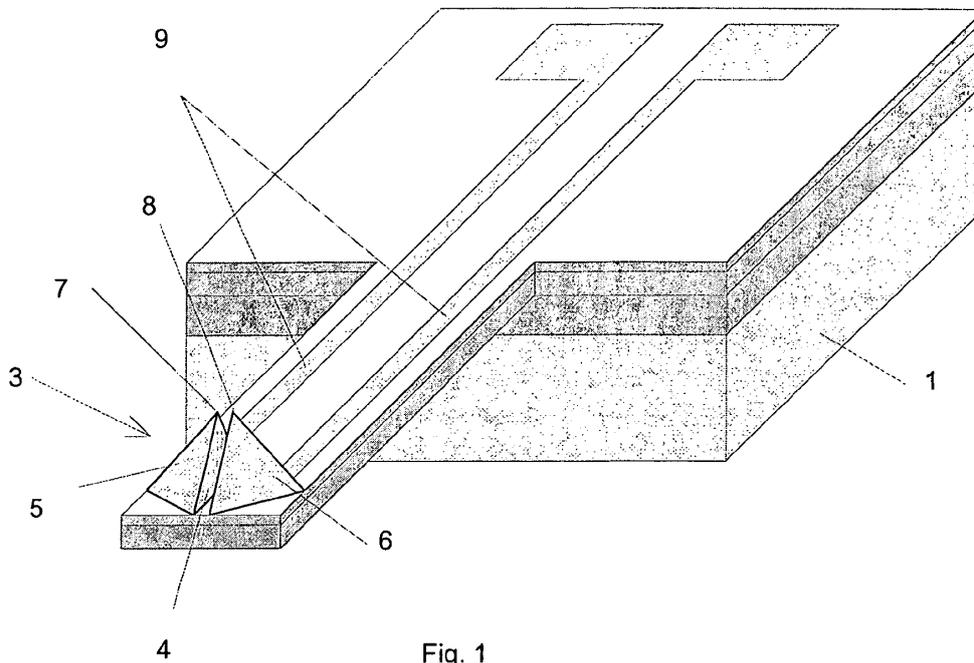
Definition statement

This place covers:

AFM or apparatus therefor wherein the force monitored is an electric interaction affected by the electric potential distribution on the sample surface, e.g. Kelvin probe microscopy and Scanning Maxwell stress microscopy.

Also probes for this kind of microscopes are classified here.

Illustrative example: EP1748447



G01Q 60/32

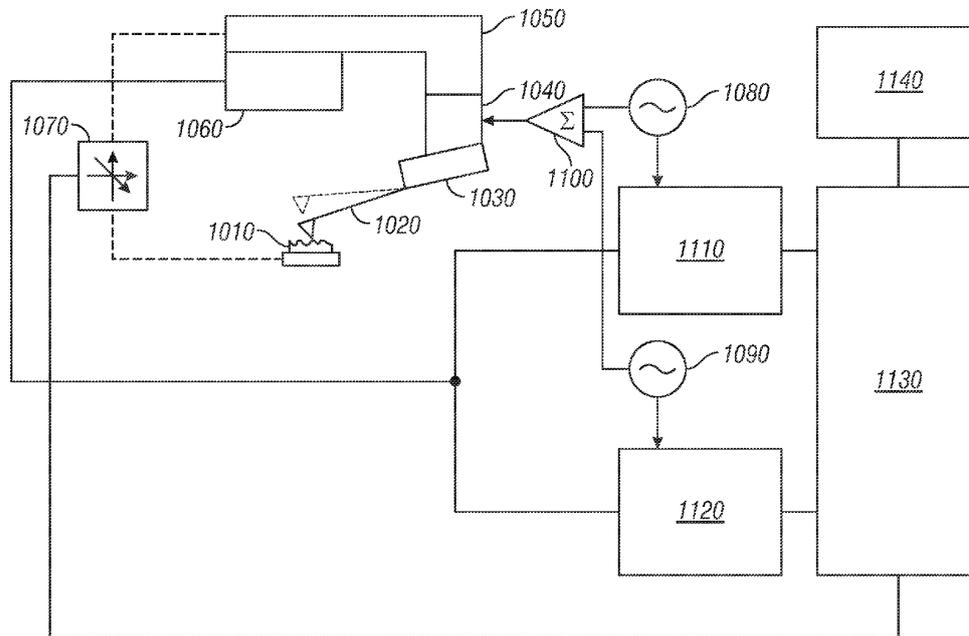
AC mode

Definition statement

This place covers:

AFM or apparatus therefor wherein the probe is a vibrating cantilever, or is mounted on a vibrating cantilever.

Illustrative example: US2011/0154546



G01Q 60/34

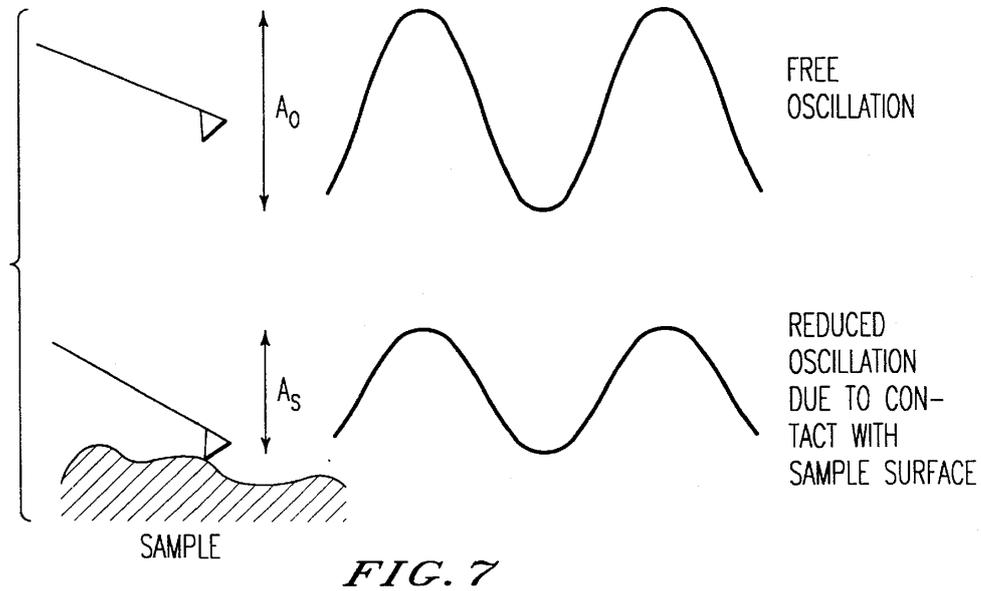
Tapping mode

Definition statement

This place covers:

AFM or apparatus therefor wherein tip of probe touches periodically the sample surface.

Illustrative example: US5519212



G01Q 60/36

DC mode

Definition statement

This place covers:

AFM or apparatus therefor wherein the probe is, or is mounted on, a static (i.e. vibrationless) cantilever.

Illustrative example: EP2131180

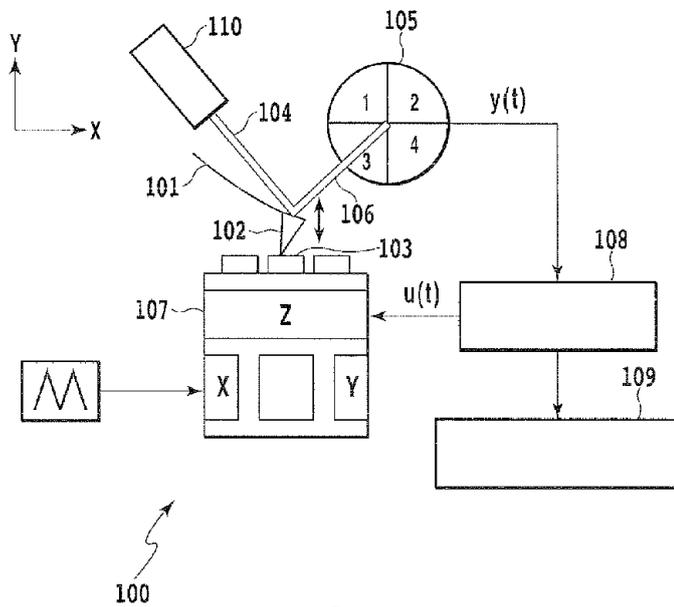


FIG.1

G01Q 60/363

{Contact-mode AFM}

Definition statement

This place covers:

AFM wherein the probe is always in contact with the surface.

Illustrative example:

EP 2 219 035 A1

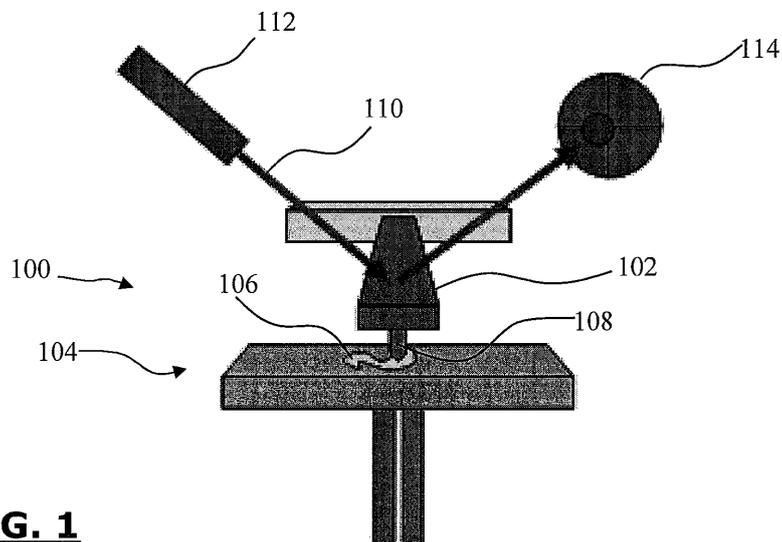


FIG. 1

G01Q 60/366

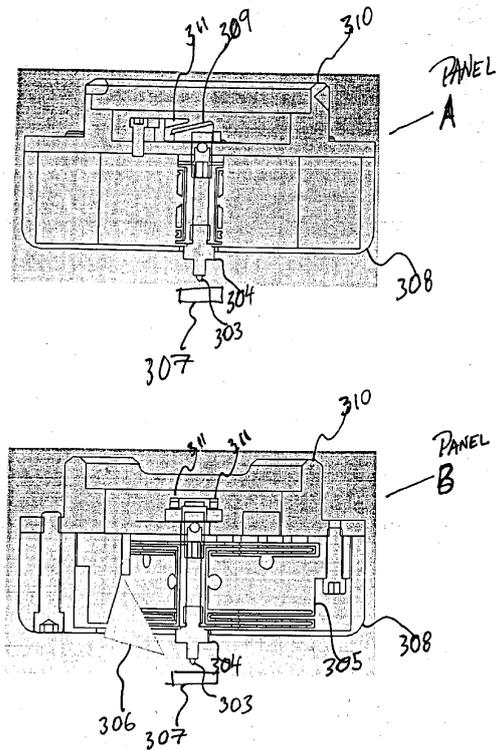
{Nanoindenters, i.e. wherein the indenting force is measured}

Definition statement

This place covers:

Device for measuring indenting force into a surface using SPM probes.

Illustrative example: US2007/0227236



G01Q 60/38

Probes, their manufacture, or their related instrumentation, e.g. holders

Definition statement

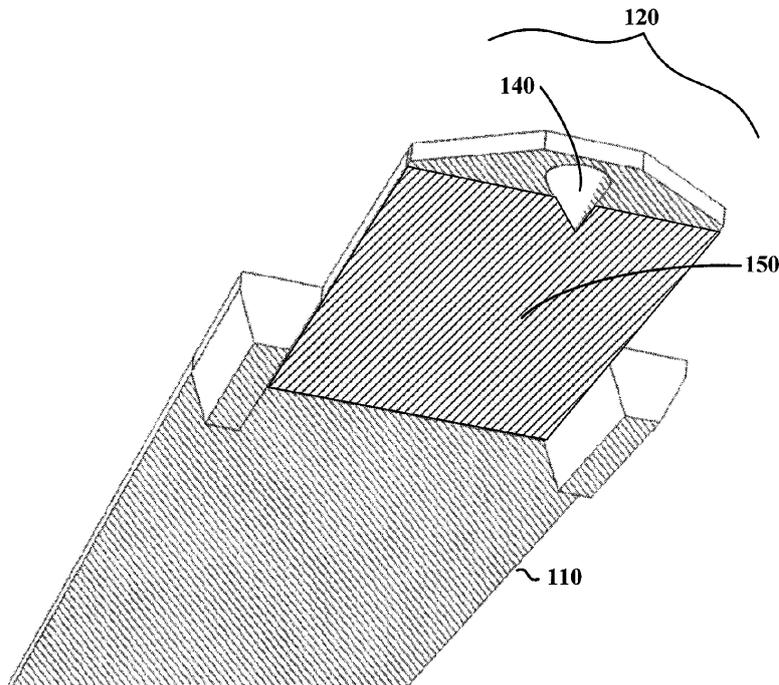
This place covers:

AFM probes, their manufacture, or their related instrumentation, e.g. holders.

Probes for AFM for special applications, like, e.g., tapping mode AFM, Kelvin Force microscopes, etc. are to be classified also in the corresponding groups.

Special shapes or processes for manufacture are classified in this group.

Illustrative example: US2010/0218288



G01Q 60/40

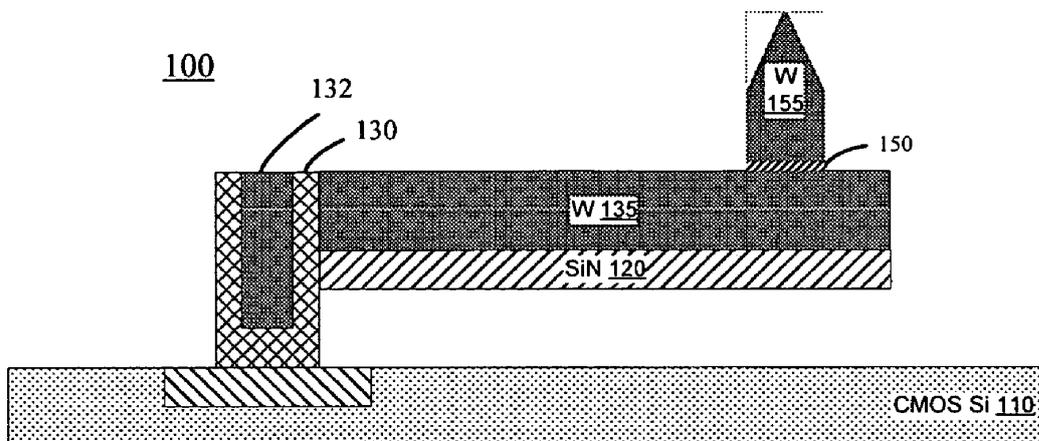
Conductive probes

Definition statement

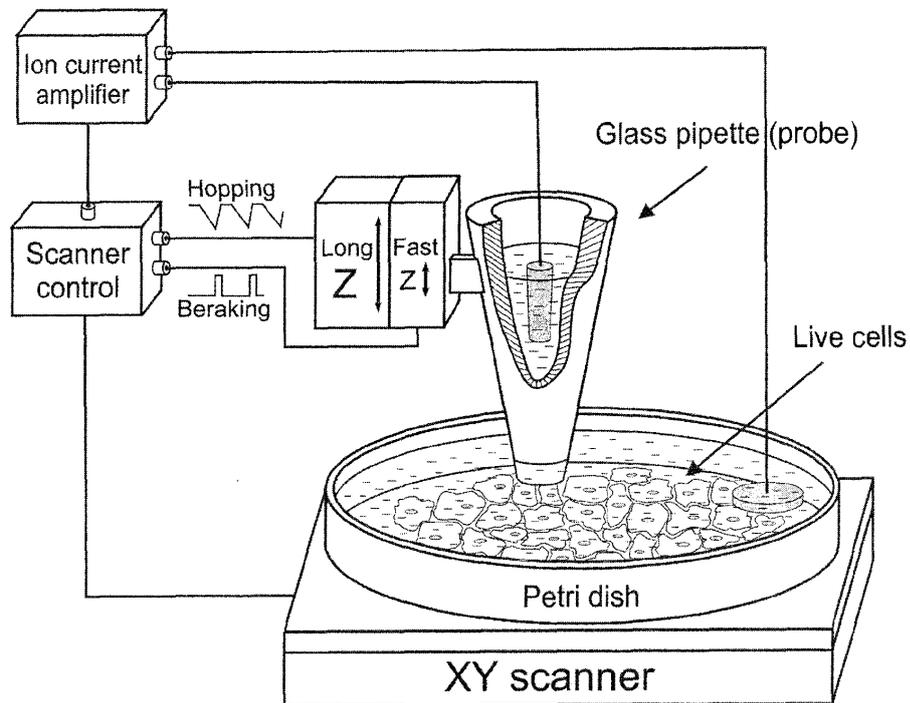
This place covers:

AFM probe that is made of a material that conducts electric charges.

Illustrative example: US2009/0001488



Illustrative example: US2011/0131690



G01Q 60/46

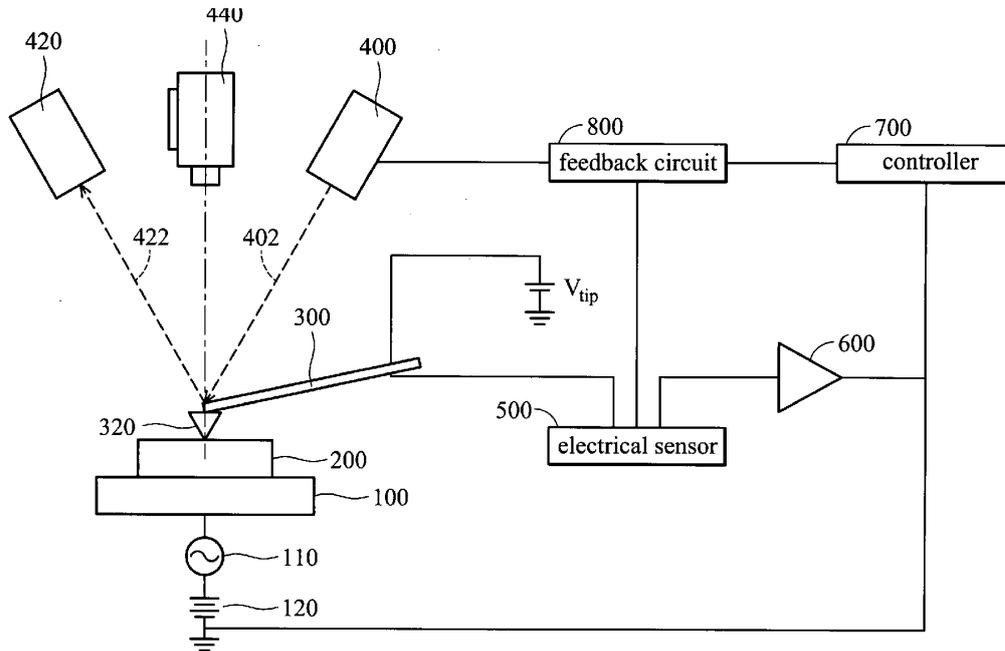
SCM [Scanning Capacitance Microscopy] or apparatus therefor, e.g. SCM probes

Definition statement

This place covers:

Methods or apparatus for SPM wherein the monitored interaction is the electrical capacity between the probe tip and the sample surface.

Illustrative example: US2005/0030054



G01Q 60/48

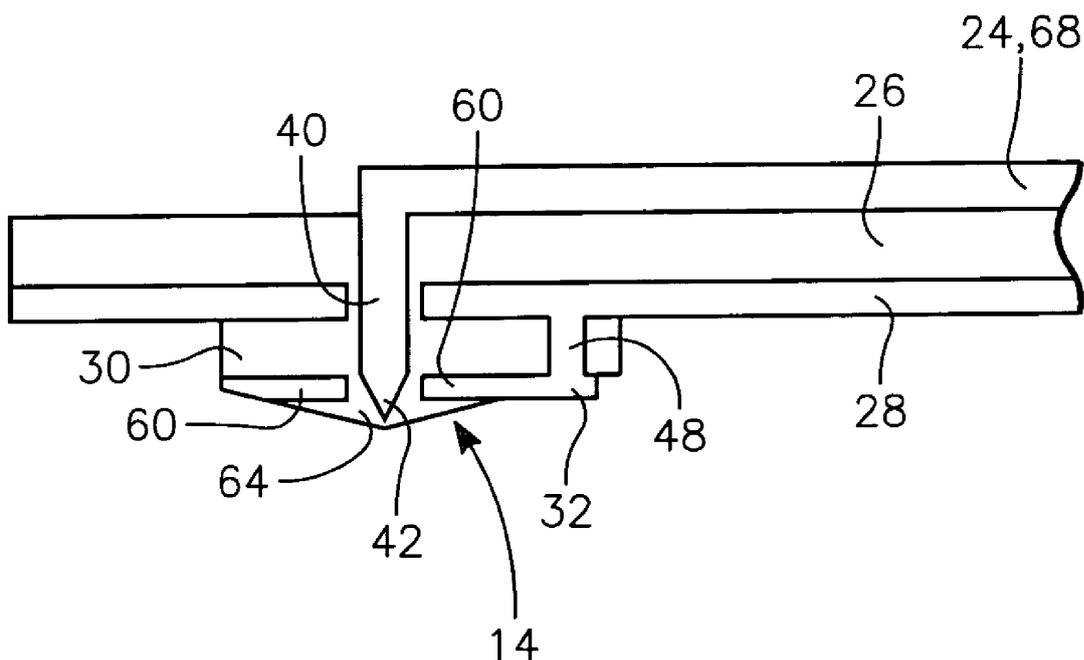
Probes, their manufacture, or their related instrumentation, e.g. holders

Definition statement

This place covers:

SCM probes, their manufacture, or their related instrumentation, e.g. holders.

Illustrative example: US7190175

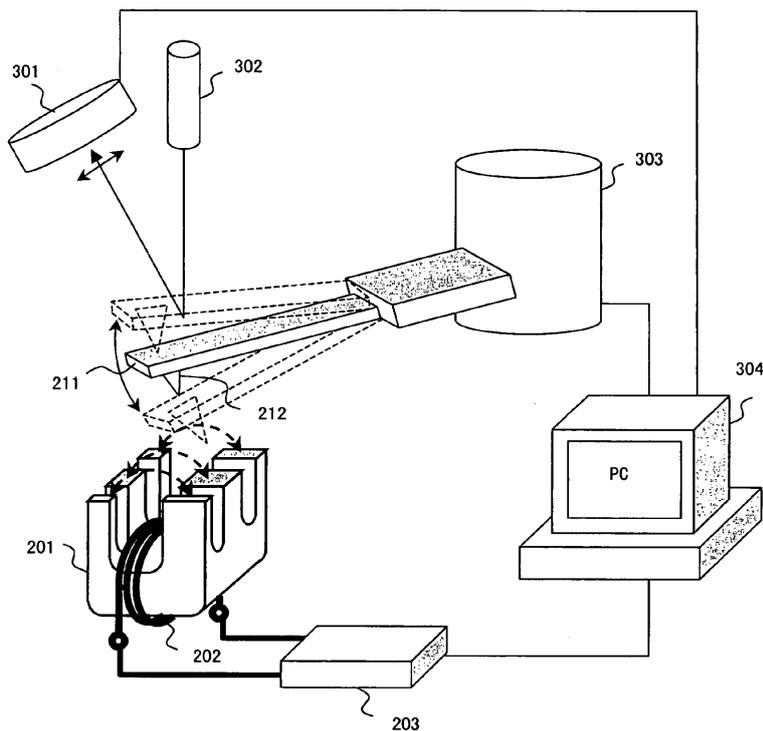


G01Q 60/50**MFM [Magnetic Force Microscopy] or apparatus therefor, e.g. MFM probes****Definition statement**

This place covers:

Methods or apparatus for SPM wherein the monitored interaction is the magnetic force between the probe tip and the sample surface.

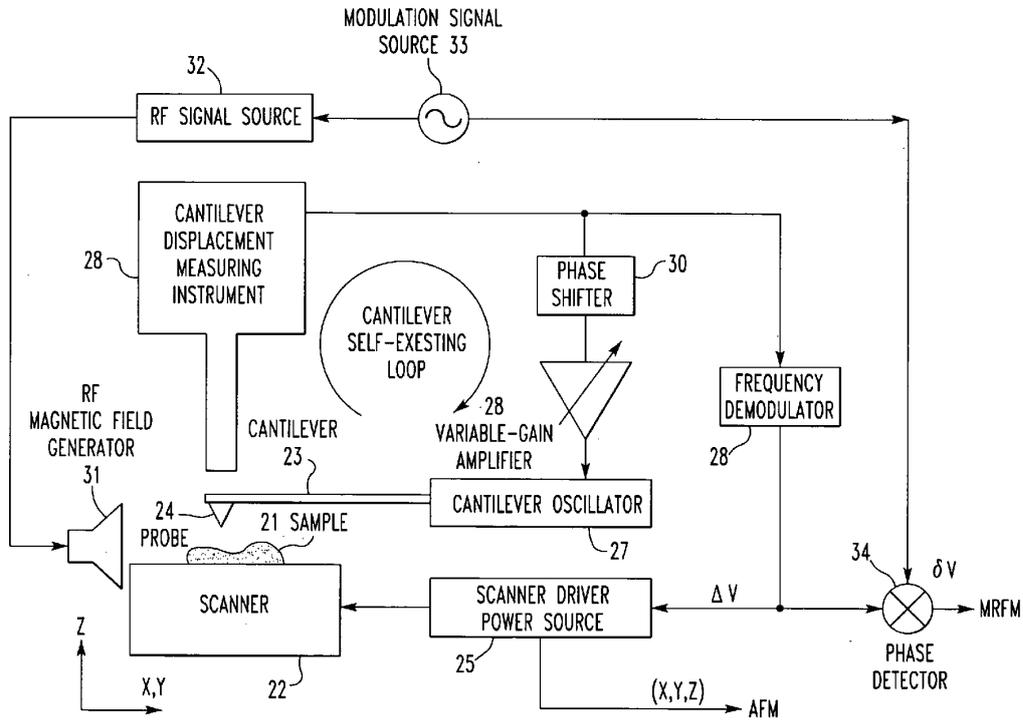
Illustrative example: US2006/0139026

**G01Q 60/52****Resonance****Definition statement**

This place covers:

MFM or apparatus therefor wherein a spin magnetic moment is induced by a specific magnetic field frequency.

Illustrative example: US2007/0216412



G01Q 60/54

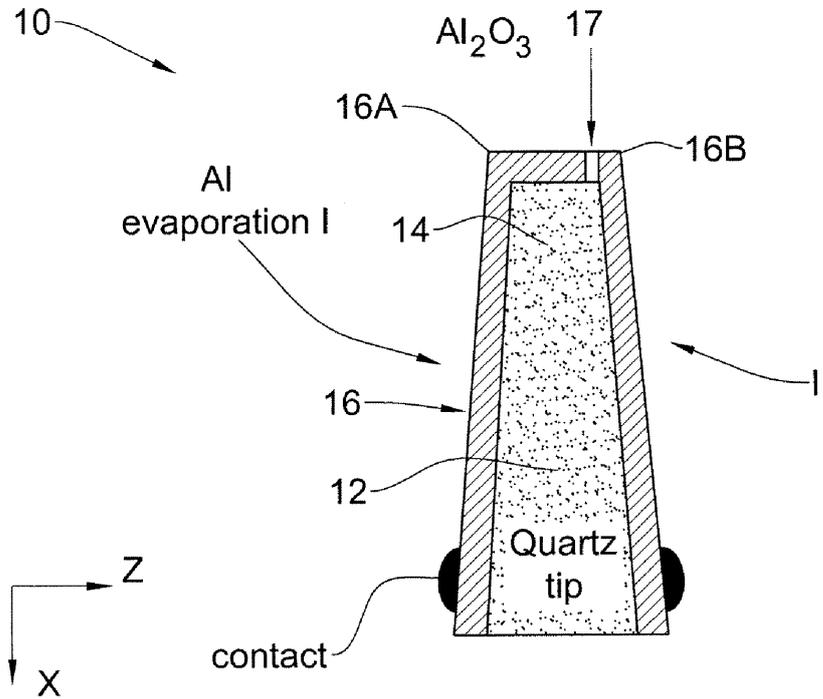
Probes, their manufacture, or their related instrumentation, e.g. holders

Definition statement

This place covers:

MFM probes, their manufacture, or their related instrumentation, e.g. holders.

Illustrative example: US2010/0207622



G01Q 60/56

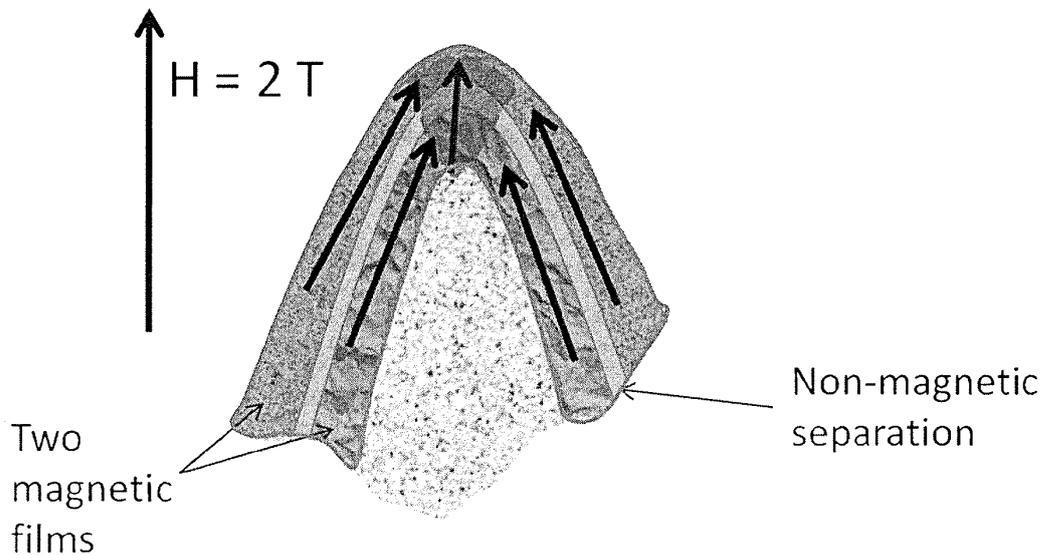
Probes with magnetic coating

Definition statement

This place covers:

MFM probe tips that are coated with some material with specific magnetic property.

Illustrative example: US2010/0138964

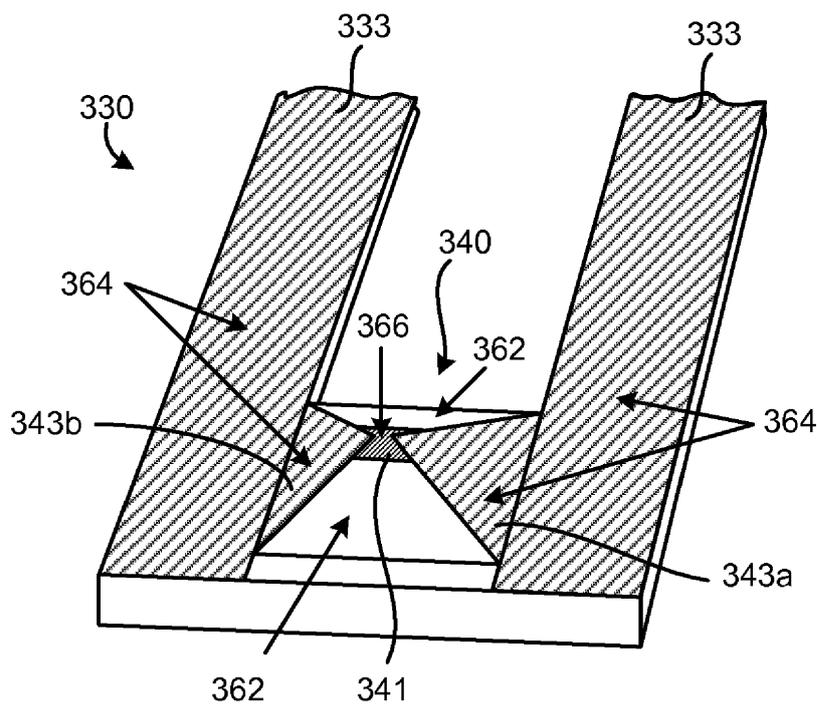


G01Q 60/58**SThM [Scanning Thermal Microscopy] or apparatus therefor, e.g. SThM probes****Definition statement**

This place covers:

Methods or apparatus for SPM wherein the monitored interaction is the heat or temperature of the sample surface.

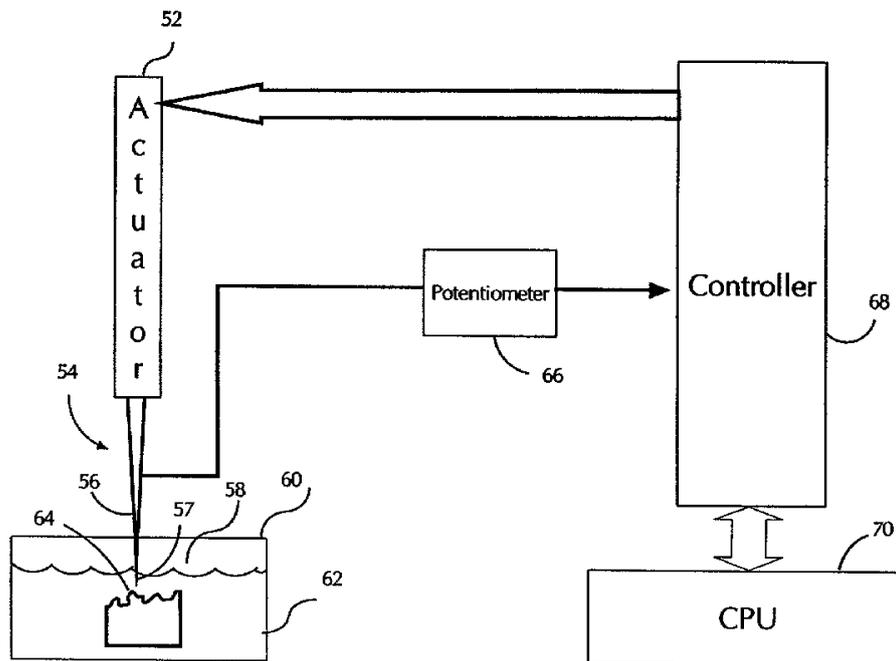
Illustrative example: US2009/0056428

**G01Q 60/60****SECM [Scanning Electro-Chemical Microscopy] or apparatus therefor, e.g. SECM probes****Definition statement**

This place covers:

Methods or apparatus for SPM wherein the monitored interaction is the Faraday current generated by an electrochemical reaction.

Illustrative example: US7156965



G01Q 70/00

General aspects of SPM probes, their manufacture or their related instrumentation, insofar as they are not specially adapted to a single SPM technique covered by group [G01Q 60/00](#)

Definition statement

This place covers:

General aspects of SPM probes, their manufacture or their related instrumentation, insofar as these probes are not specially adapted to a single particular type of SPM technique covered by group [G01Q 60/00](#) and subgroups.

G01Q 70/02

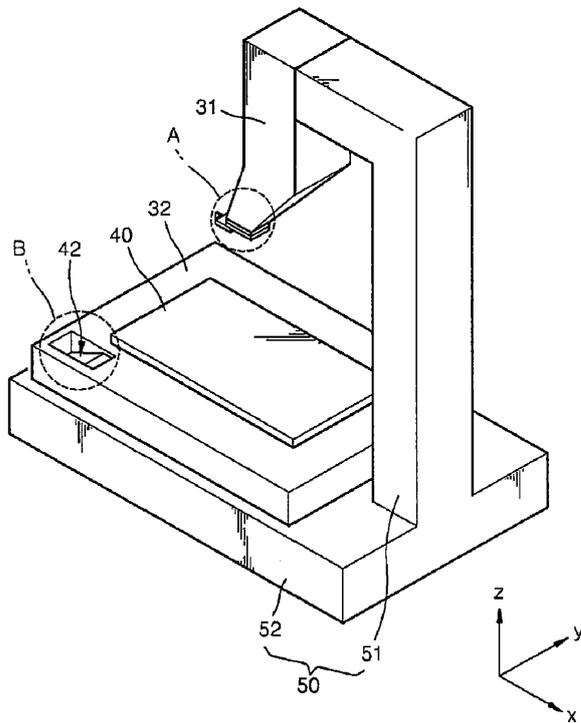
Probe holders

Definition statement

This place covers:

General aspects of SPM probe holders.

Illustrative example: US2010/0037360



G01Q 70/04

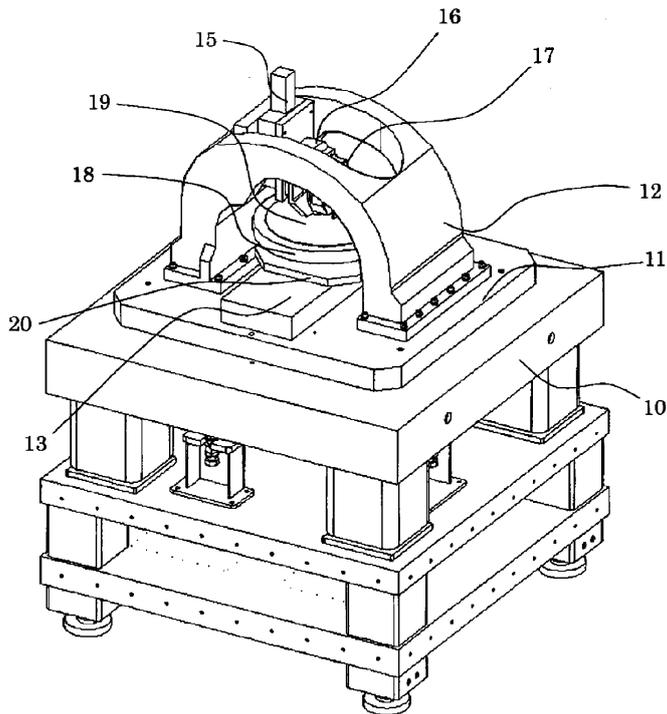
with compensation for temperature or vibration induced errors

Definition statement

This place covers:

General SPM probe holders with integrated means to adjust the probe to correct for errors caused by temperature variations or vibrations.

Illustrative example: US2009/0255016



References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Error compensation in general	G01Q 30/06
Protection of the scanning probe microscope in general	G01Q 30/18

G01Q 70/06

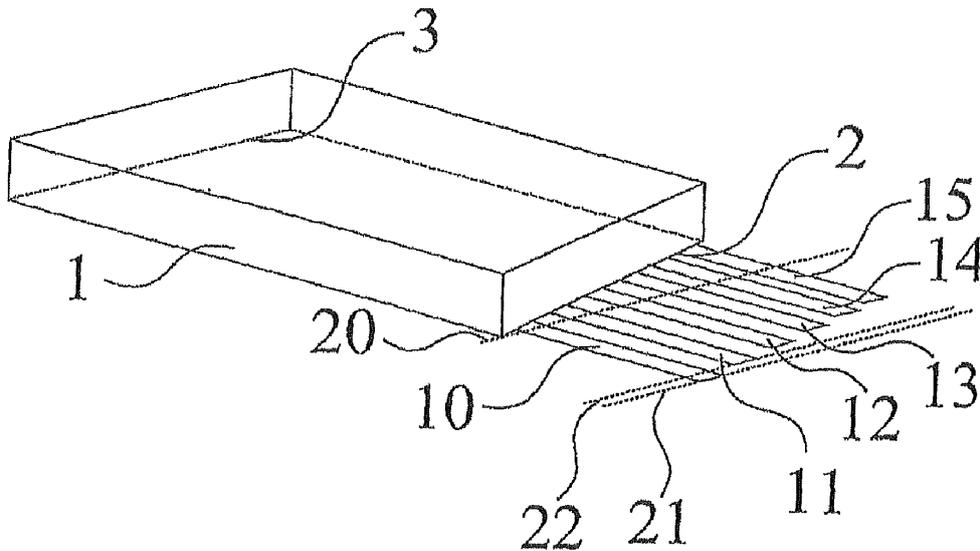
Probe tip arrays

Definition statement

This place covers:

General SPM probes wherein multiple tips of similar characteristics form a line or a matrix.

Illustrative example: US2010/0218284



G01Q 70/08

Probe characteristics

Definition statement

This place covers:

Specific characteristics of general SPM probes.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Process of probe fabrication	G01Q 70/16
------------------------------	----------------------------

Special rules of classification

Specific characteristics like shape, material, etc. are covered by the subgroups

[G01Q 70/10](#) - [G01Q 70/14](#).

G01Q 70/10

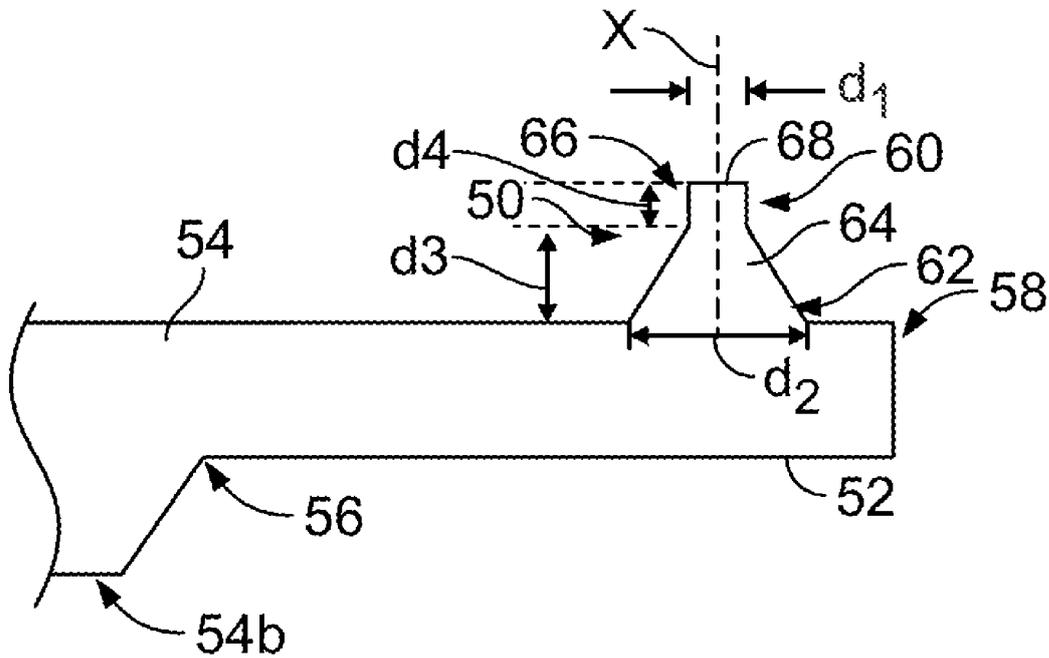
Shape or taper

Definition statement

This place covers:

Specific physical form, degree of slope or angle of the tip in a general SPM probe. With "probe" both tip and cantilever are meant.

Illustrative example: US2009/005092



G01Q 70/12

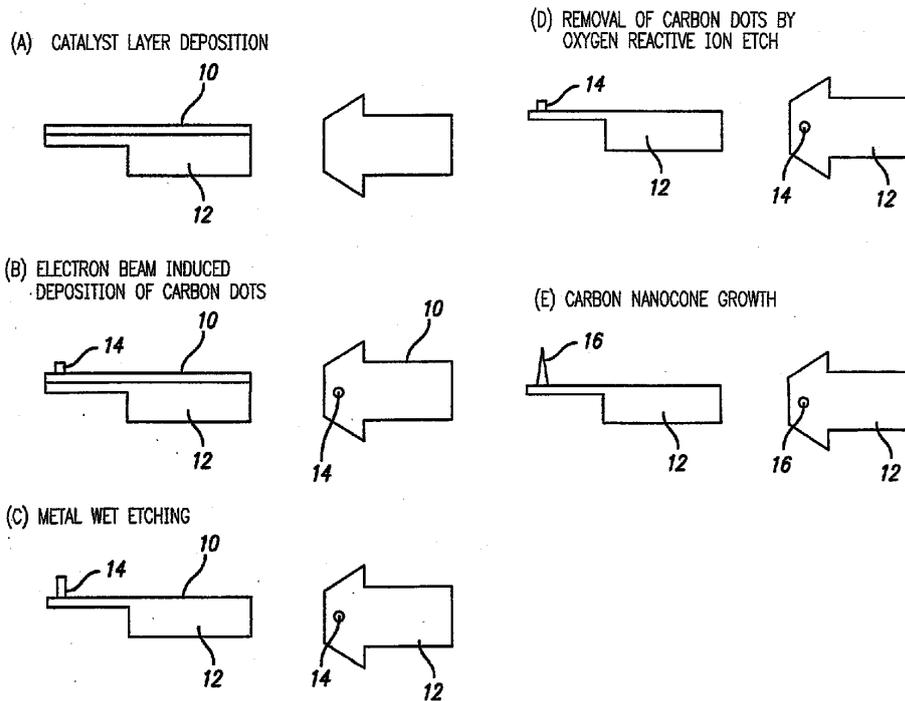
Nanotube tips

Definition statement

This place covers:

General SPM probes having a nanosized tube such as Carbon nanotube.

Illustrative example: US2010/0229265



G01Q 70/14

Particular materials

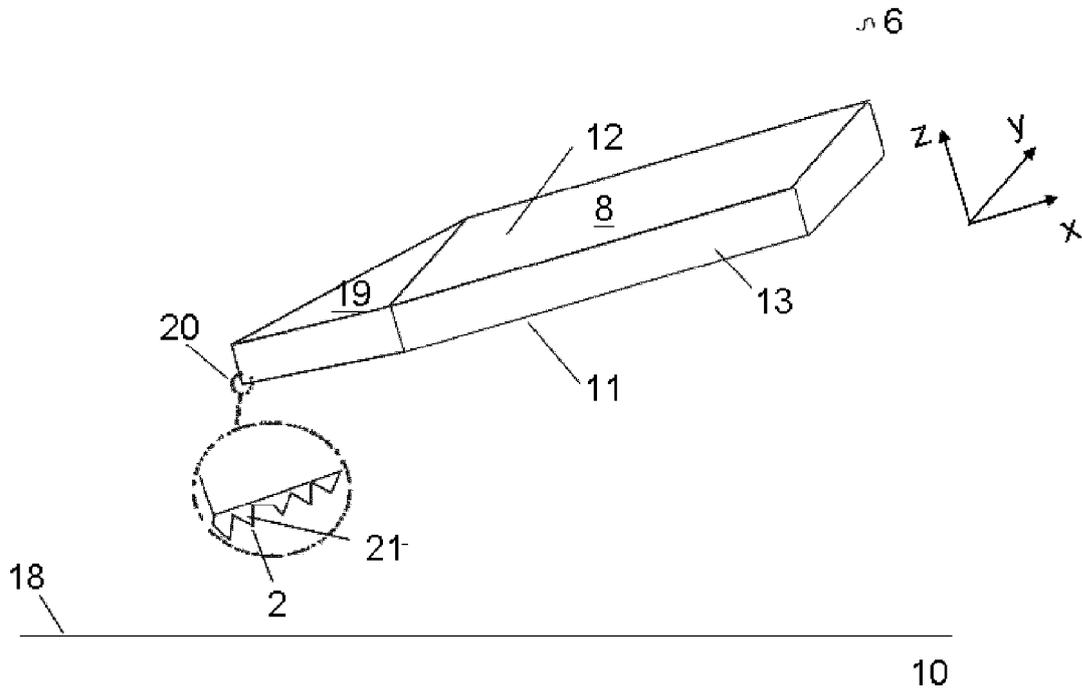
Definition statement

This place covers:

Specific choice of materials for general SPM probes or components thereof. For example, where a cantilever or a coating on the tip is made of some material that gives a particular property to the scanning probe.

Materials of cantilever and/or tip.

Illustrative example: US2009/0313730



G01Q 70/16

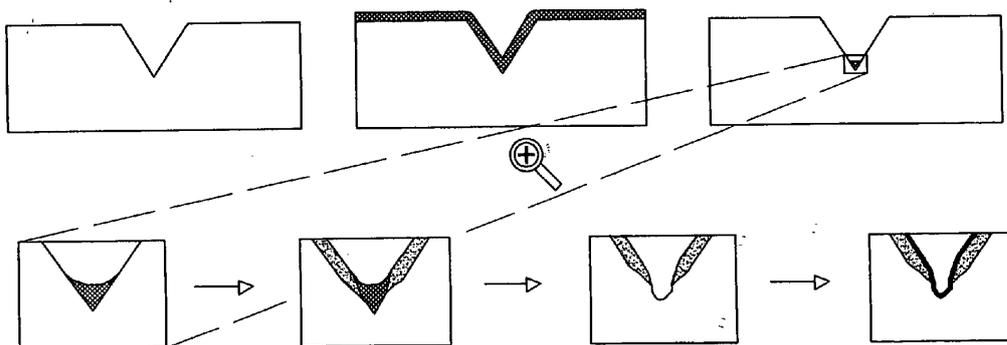
Probe manufacture

Definition statement

This place covers:

Manufacture aspects of general SPM probes.

Illustrative example: US2011/039100



Fabrication scheme for the silicon oxide pyramid containing a nano scale metal tip.

Special rules of classification

Manufacture of probes for particular kinds of SPM (e.g. AFM, STM, SNOM) are classified in the corresponding [G01Q 60/00](#) subgroup.

G01Q 70/18

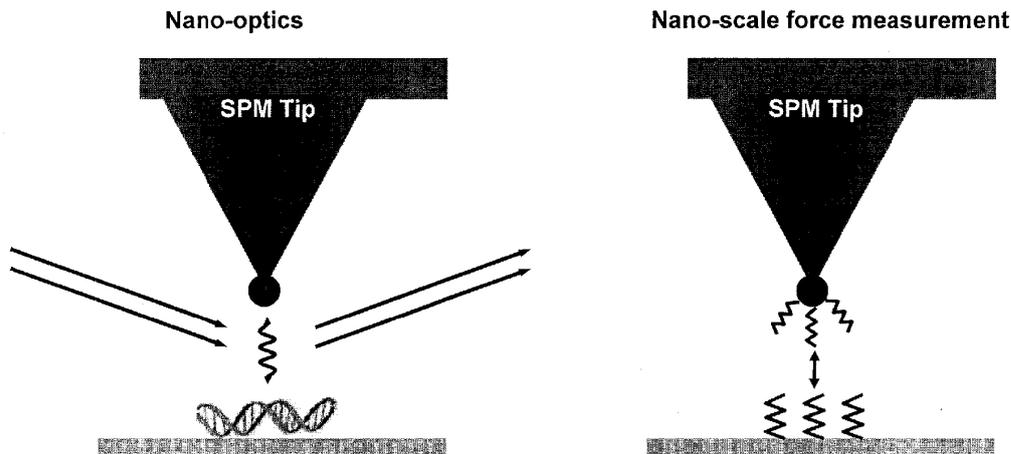
Functionalisation

Definition statement

This place covers:

General SPM probes, wherein specific particles are added to the tip to give it another characteristic, e.g. specific chemical receptor for biochemical analysis.

Illustrative example: US2008/0093550



References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Functionalized AFM probes	G01Q 60/38
---------------------------	----------------------------

G01Q 80/00

Applications, other than SPM, of scanning-probe techniques (manufacture or treatment of nanostructures [B82B 3/00](#); recording or reproducing information using near-field interaction [G11B 9/12](#), [G11B 11/24](#), [G11B 13/08](#))

Definition statement

This place covers:

Specific applications, different from SPM, of scanning-probe techniques.

References

Limiting references

This place does not cover:

Manufacture or treatment of microstructures	B81C
Manufacture or treatment of nanostructures	B82B 3/00
Recording or reproducing information using near-field interaction	G11B 9/12 , G11B 11/24 , G11B 13/08

Informative references

Attention is drawn to the following places, which may be of interest for search:

Specific SPM techniques, apparatus therefor or components thereof, e.g. probes	G01Q 60/00
General aspects of SPM probes	G01Q 70/00