

THE SOLAR THERMAL COLLECTOR INNOVATOR

Professor Yin Zhiqiang, PhD
Chairman and Chief Scientist
Tsinghua University and Tsinghua Solar Systems, Ltd.
Beijing, China

“We enjoy our strong point of up-to-date technology, especially the technology of our Solar Selective Coating on Evacuated Tubes, which was first invented by our company.”

Studying evacuated tube solar collector systems while a visiting scholar in Austria in the early 1980s, Professor Yin Zhiqiang of Tsinghua University’s Department of Electrical Engineering believed that it was a technology important for China and the world and that he could improve upon the basic German and Austrian designs in order to increase absorption efficiency. In 1984 he invented and patented the magnetron sputtering gradient aluminum solar selective absorbing coating and the production process to apply it to the evacuated glass tubes. With the support of Tsinghua Holding Company, the technology enterprise investment arm of Tsinghua University, and investments from two Beijing companies, Professor Yin founded Tsinghua Solar Systems to commercialize the technology, especially for residential and commercial water heating. The company has the world’s largest evacuated glass tube solar collector production line, producing some 10 million tubes a year. Professor Zhiqiang Yin is “the Solar Thermal Collector Innovator.”

Improving Evacuated Glass Tube Solar Collection Technology

Some people in China have long been looking for alternatives to coal as a source of energy for China. Solar energy has received attention from visionary Chinese S&T leaders as a renewable energy source for some thirty years. Solar energy is an ecologically attractive alternative to coal-fired energy sources. It is estimated that some 30 million Chinese households have individual collectors on their rooftops to heat their water, an impressive number that owes a good deal to the leadership of Professor Yin.

Professor Yin’s designs collect solar thermal energy in evacuated borosilicate glass tubes that contain metal absorber plates. The glass tubes protect the metal absorber plates from the weather and other environmental factors, such as birds. The basic design follows the German model. However, Professor Yin substantially improved the solar collection efficiency of these evacuated tube systems with his 1984 invention of the magnetron sputtering gradient aluminum solar selective absorbing coating and the production process to apply it to the evacuated glass tubes. It is a “film” which is made of aluminum (for its roughness) and a layer of incompletely nitrated aluminum nitrate on top of it. As a result, more light is absorbed and less heat is emitted back out of the

system. Professor Yin's innovation allowed his collection tubes to absorb 92% of the incident light. The layered film is "sputtered" on, which means it is deposited onto the collector surface in a vacuum chamber in a manufacturing process some-what similar to spraying it on.

Professor Yin sought in 1984 and received 10 patents from the State Intellectual Property Office of China for his coating improvements and the associated methods of manufacture, the sputter coating machine. Professor Yin was honored in 1988 with a Chinese invention prize for his innovations to solar collection technology. In 2000, at the World Renewable Energy Conference, he presented a paper regarding solar collection technology improvements that won the "best paper" award for solar energy. In 2005, at the World Solar Conference he won the Vickers industrial achievement award and the International Solar Energy Society "Achievement through Action Award."

Professor Yin founded Tsinghua Solar in 1984 to commercialize his technology with the support of Tsinghua Holding Company, the investment arm of Tsinghua University. Tsinghua Holding owns the biggest share-stake in the company. Two companies, Beijing First Light Industry Holding Company and Beijing Capital Steel Stock Company own substantial shares of the Tsinghua Solar. Professor Yin owns a significant minority stake and a number of Tsinghua professors own small stakes in the company.

Tsinghua Solar has three manufacturing facilities, two in Beijing, including the world's largest evacuated glass tube solar collector production line, and one in Hunan Province. The finished evacuated tubes are placed in parallel arrays and installed on building roof tops, designed in architecturally as facades, or placed as free-standing collection devices near buildings.

Selling to Homeowners; Focusing on Hotels

Solar thermal collectors used in China before Professor Yin's design improvements were effective only about six months of the year in the cooler climate of northern China. Professor Yin's designs are effective about ten months a year in cool climates and are designed not to freeze or crack. These innovations allowed his company to market aggressively in the north of China. Tsinghua Solar has been at the fore-front of selling water heating systems to Chinese homeowners and these marketing efforts have produced big results in the country—some 30 million homes. As few as 14 collector tubes will heat sufficient water for a family of four. Millions more Chinese homeowners, owing to the three decades of rapid economic growth in China, are potential customers. The Chinese domestic marketplace amounts to about 90% of company sales.

Such a big Chinese marketplace encourages pirates. Many companies in China manufacture and sell unlicensed copies of Tsinghua Solar's thermal collectors. Tsinghua Solar's products are designed to last at least 15 years and experience says that longer than two decades of product life is common. Pirate products often do not meet their

manufacturing quality standards, so yield neither the efficiency nor the durability of their product. Company manufacturing quality meets ISO 9001 certification standards.

The elegance and efficiency of Professor Yin's designs have allowed the company to export to cool climate countries such as Japan and Korea and Germany and Europe. But, Professor Yin sees emerging market countries such as Brazil, the Middle East, South Africa, and Southeast Asia as growth opportunities. The company is experiencing big growth in the "emerging markets" of its own country, in the southern provinces of Guangdong, Yunnan, and Hainan Island.

Tsinghua Solar marketing strategy focuses on hotels while continuing to sell to residential customers. Their marketing strategy fits the characteristics of their technology: Solar thermal collection technologies work best where there is a lot of sunshine, where that sunshine is present nearly every day, and where that sunshine is present year-round with hot to mild, but not cold, temperatures. Solar collection technologies work not at all at night. Who needs a lot of water? Hotels. They calculated a 1.9 year pay-back period for a hotel project on the Chinese island of Hainan. The hotel reported to them that the pay-back took only a 1.2 year period. They have calculated a four to five-year pay-back period for a big hotel project in Dubai and are anxious to discover the real-world actual results.

Solar thermal collector systems work especially well at water heating and do so cleanly. The company estimates that, when compared with the coal-fired water heating that is common in China, every 5 million collector tubes deployed reduces carbon dioxide emissions by 12.8 tons, carbon monoxide emissions by 6800 tons, dust by 56,000 tons, sulfur dioxide by 17,000 tons, and nitric oxides by 45,000 tons. Professor Yin's solar thermal collector innovations will continue to yield big improvements in China's air quality.