Commercialization of new solar technology to boost solar efficiency

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A pioneer in solar power in the 1990s before it became "sexy," University of Houston Professor Alex Freundlich recently entered into a collaborative research agreement with U.K.-based start-up QuantaSol for the development of the next generation of super efficient solar cells.

"A sabbatical 20 years ago brought me to Houston from France, when at the time Houston was one of few places in the world to find a steady support for solar energy research," said Dr. Alex Freundlich, research professor of physics and electrical and computer engineering, Center for Advanced Materials, University of Houston. "One of the reasons I decided to stay in Houston was the opportunity to work with NASA and to continue my research in high efficiency solar energy materials and devices. Since the early days of the space program solar cells have been the workhorse of space exploration and the need of satellites with more onboard power has fueled high risk research in solar cells. In the past few decades, most major advances in the area of high efficiency solar cells came from space development and exploration."

Freundlich met Keith Barnham, co-founder of QuantaSol, a former faculty at Imperial College London, early in his career while working as a staff scientist on solar cells at the French National Scientific Research Laboratory (CNRS).

"Keith convinced me that low dimensional structures held a promise for great improvements in solar cells. As a physicist these quantum structures opened access to refreshing and sophisticated device physics. I

believe that over the years the type of science that Keith and I have dedicated our career to has not only produced remarkable device results but created an excellent opportunity for the intellectual development of students and faculty involved in these project," said Freundlich.

Soon after joining the University of Houston, Freundlich and his colleagues were using nanotechnology before it became hip. It allowed for flexibility with making devices that were both efficient and radiation tolerant.

"Our early investigation of strain-engineered indium phosphide based single junction quantum well cell at the University of Houston demonstrated the possibilities to reduce by over threefold the overall solar cell absorber thickness compared to a conventional counterpart while maintaining the device superior performance. The approach also appeared to be an interesting way to improve the radiation, tolerance of solar cells for space," said Freundlich.

Freundlich was even able to test his quantum well solar cell on a space shuttle piggy-backing off the University of Houston Wake Shield Facility Project in 1995, funded by NASA.

"In collaboration with our colleagues from the Naval Research Laboratories, we demonstrated that the solar cells were superior to their conventional counterparts by a factor of two in terms of space radiation tolerance," said Freundlich. "Usually, you start working two to three years before patents, so with a project that started in 1992, we filed the original patent in 1995, and were awarded the patent in 1998."

Later Freundlich expanded the approach to multispectral solar energy conversion and showed that these nanostructures offered the possibility to significantly improve the efficiency of tandem solar cells and was awarded two additional patents for use of quantum-engineered structures

for tandem solar cell applications.

Two years ago, Freundlich published a paper reporting a new generation of solar cells that could more efficiently convert sunlight in a range of wavelength where it was difficult to make efficient cells.

"Using quantum wells made with dilute nitride III-V semiconductor alloy we have been able to demonstrate key elements necessary to boost efficiencies well beyond the present technology," said Freundlich. "Combined with our initial patents and QuantaSol's technology heritage, this creates the grounds for transformative collaborative research that could lead to game-changing efficiency improvements in solar cells and warrants a rapid transfer of the technology for commercial use. This time the mission is on planet earth and the goal is to develop ultra-efficient solar cells for utility scale concentrator markets."

There are two aspects to the recent licensing agreement and collaboration with the University of Houston and QuantaSol. QuantaSol licensed existing solar cell technology from the University of Houston and will collaborate on advance solar cell technology by adopting dilute nitrides to boost absorption and solar efficiency to create a "super cell." The collaboration with University of Houston and QuantaSol will make the manufacturing process simpler and more cost effective, while further improving solar cell efficiency. The development of efficient and affordable solar cells for clean energy is a major global challenge.

"We've already tested the benefits of using Houston's dilute nitride materials in the way we engineer quantum wells in our cells," said Barnham. "The exclusive worldwide license is a strategic move to ensure we maintain our performance advantage, and we will work with our colleagues in Houston to develop the techniques further in commercial production in 2010."

The use of dilute nitrides allows QuantaSol, an independent designer and manufacturer of strain-balanced quantum-well solar cells, to reduce the number of quantum well layers it needs to introduce into each junction, while maintaining or increasing solar efficiency. This further reduces the thickness and manufacturing cost of its production devices.

"This collaboration and commercialization of technology in solar cells from the laboratory to the marketplace in this worldwide license agreement with QuantaSol demonstrates the quality of research conducted at the University of Houston," said Donald Birx, vice president for research at University of Houston. "These joint efforts will advance solar cell technology and help increase our use of renewable resources with breakthroughs at the level of device design, involving novel semi conductor approaches at the nano-material level."

"The sun is the most abundant source of energy available and will be available long after we are gone," said Freundlich. "The sun is going to shine for another five to six billion years. I am very happy to see a breakthrough in solar energy that improves our way of life and quality of life."

Source: University of Houston (news : web)