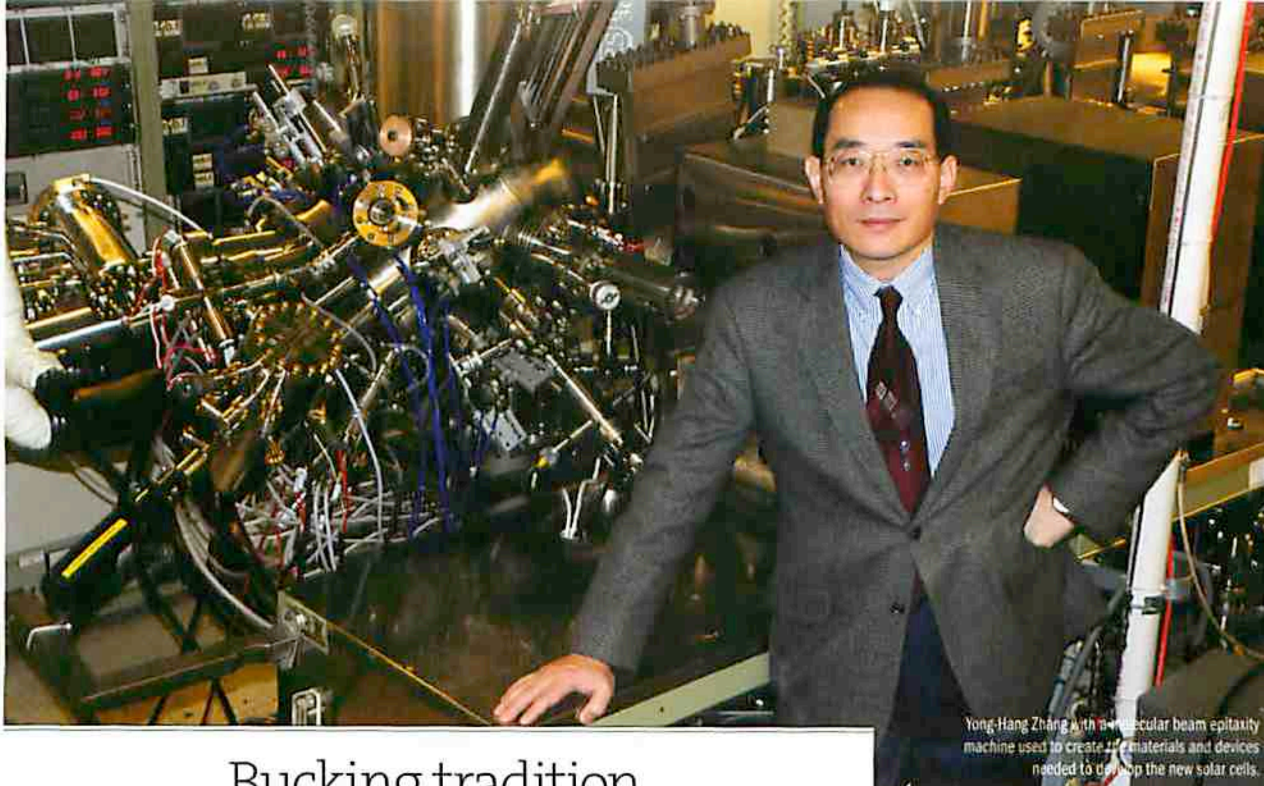

Yong-Hang Zhang with a molecular beam epitaxity machine used to create the materials and devices needed to develop the new solar cells.

Bucking tradition

ASU researcher is working on an innovative solar cell that costs less, produces more energy

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An Arizona State University researcher and professor is developing an advanced solar cell with higher energy conversion efficiency for low-cost concentrator solar panels.

The panels, also known as concentrator photovoltaics (CPV), use relatively inexpensive optics such as mirrors or lenses to "concentrate" or focus light from a relatively broad collection area onto a much smaller area of fewer solar cells. That significantly reduces the overall costs.

"By 2011, the market for space and land-based solar panels is expected to grow to $30 billion," says Yong-Hang Zhang, of ASU's Department of Electrical Engineering, who is leading a group of researchers on the solar project. "But the land-based market is presently dominated by silicon-based solar panels and its growth is limited by the availability of silicon."

With a traditional solar panel, a large portion of sunlight energy is not converted into electricity because numerous light rays contain too little energy or are mismatched with the band gap of the semiconductor material. The band gap determines which of the sun's rays the solar panel will absorb. Multijunction solar cells allow absorption of more sunlight to generate more electricity than traditional solar cells, making the CPV systems much more cost effective.

Funded by a $1.5 million contract from the Air Force Research Laboratory and two $1 million grants from Science Foundation Arizona, Zhang's research calls for an innovative multijunction solar cell design that uses lattice-matched II/VI ZnCdMgSeTe and III/V AlGaAsSb semiconductors. The matching of lattice structures between two different semiconductor materials allows for a range of band gaps, permitting the solar panels to use various types of light from the sun, ranging from ultraviolet to infrared, which currently are used by traditional solar panels. Zhang's solar panels will absorb a larger amount of sunlight and produce more energy in return.

> Multijunction solar cells, made of low-cost materials such as glass or plastic, are a relatively new land-based solar energy technology.

"The key innovation of this research," Zhang notes, "is to build solar cells with many junctions to improve its conversion efficiency." The design's potential for an increased number of junctions (five or more) allows for an ultra-high conversion efficiency of 44 percent, a 42 percent improvement compared to the most state-of-the-art multijunction solar cell available in today's market. Compared to the highest recorded efficiency of traditional silicon solar cells, 25 percent, these new multijunction solar cells could make a large impact on sustainability efforts around the globe while having a much lower price tag.

Zhang and his collaborator, Jacek Furdyna of the University of Notre Dame and world- renowned expert in II/VI semiconductors, will use molecular beam epitaxity (MBE) machines to create the materials and devices needed to develop the new solar cells. Some of the machines are housed in ASU's MBE laboratory, part of the MBE Optoelectronics Group, where Zhang is lead researcher. The MBE laboratory is equipped with three solid-source MBE chambers for growing III-V semiconductor materials. The group is affiliated with ASU's Center for Nanophotonics, where Zhang is director.

"The goal of the U.S. Department of Energy's Solar America Initiative is to make solar energy technologies cost-competitive by 2015, and the Arizona Corporation Commission has developed renewable energy standards that require 15 percent of all electric power in Arizona be derived from renewable resources by 2025," says Zhang. "Our solar cell design is a potentially effective way to drastically reduce the cost of solar panels and make these goals a reality."

ASU leads the nation in renewable energy and semiconductor optoelectronics research. ■