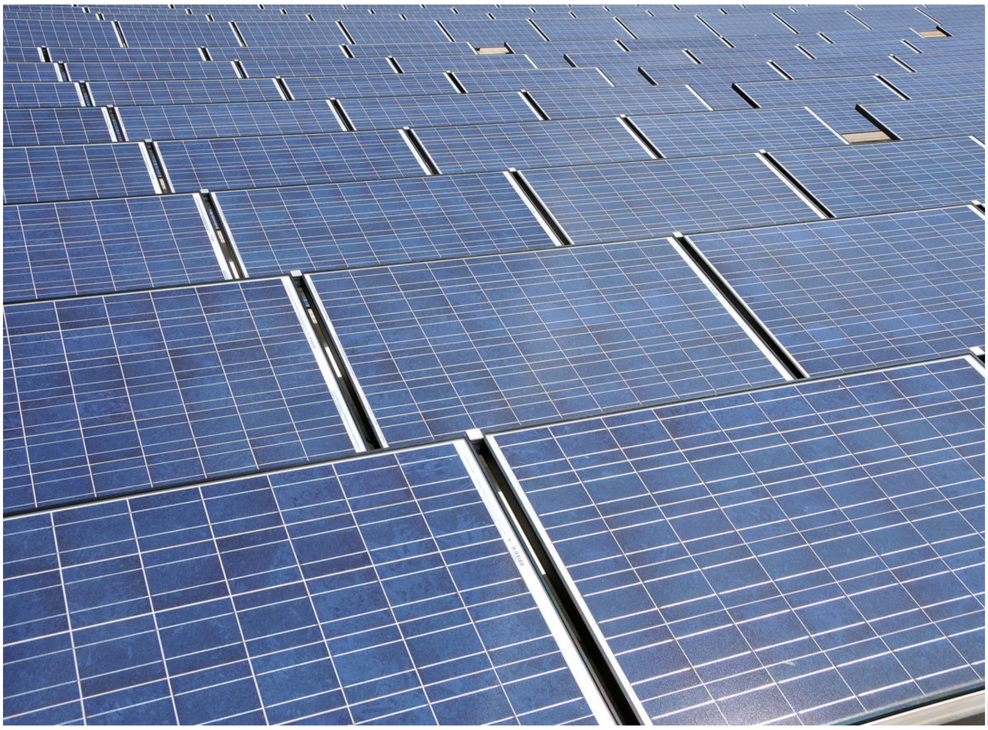
New connection between stacked solar cells can handle energy of 70,000 suns

NC State University



North Carolina State University researchers have come up with a new technique for improving the connections between stacked solar cells, which should improve the overall efficiency of solar energy devices and reduce the cost of solar energy production. The new connections can allow these cells to operate at solar concentrations of 70,000 suns worth of energy without losing much voltage as “wasted energy” or heat.

Solar field on the roof of the Keystone Science Center.

Stacked solar cells consist of several solar cells that are stacked on top of one another. Stacked cells are currently the most efficient cells on the market, converting up to 45 percent of the solar energy they absorb into electricity.

But to be effective, solar cell designers need to ensure the connecting junctions between these stacked cells do not absorb any of the solar energy and do not siphon off the voltage the cells produce – effectively wasting that energy as heat.

“We have discovered that by inserting a very thin film of gallium arsenide into the connecting junction of stacked cells we can virtually eliminate voltage loss without blocking any of the solar energy,” says Dr. Salah Bedair, a professor of electrical engineering at NC State and senior author of a paper describing the work.

This work is important because photovoltaic energy companies are interested in using lenses to concentrate solar energy, from one sun (no lens) to 4,000 suns or more. But if the solar energy is significantly intensified – to 700 suns or more – the connecting junctions used in existing stacked cells begin losing voltage. And the more intense the solar energy, the more voltage those junctions lose – thereby reducing the conversion efficiency.

“Now we have created a connecting junction that loses almost no voltage, even when the stacked solar cell is exposed to 70,000 suns of solar energy,” Bedair says. “And that is more than sufficient for practical purposes, since concentrating lenses are unlikely to create more than 4,000 or 5,000 suns worth of energy. This discovery means that solar cell manufacturers can now create stacked cells that can handle these high-intensity solar energies without losing voltage at the connecting junctions, thus potentially improving conversion efficiency.

“This should reduce overall costs for the energy industry because, rather than creating large, expensive solar cells, you can use much smaller cells that produce just as much electricity by absorbing intensified solar energy from concentrating lenses. And concentrating lenses are relatively inexpensive,” Bedair says.

The paper, “Effect of GaAs interfacial layer on the performance of high bandgap tunnel junctions for multijunction solar cells,” was published online Sept. 5 in Applied Physics Letters. Lead author of the paper is Joshua Samberg, a Ph.D. student at NC State. Co-authors include NC State Ph.D. students Zachary Carlin, Geoff Bradshaw and Jeff Harmon; Dr. Peter Colter, a research assistant professor of electrical engineering at NC State; J.B. Allen, a master’s student at NC State; and Dr. John Hauser, an emeritus professor of electrical engineering at NC State. The research was funded by the U.S. Department of Energy and the National Science Foundation.

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