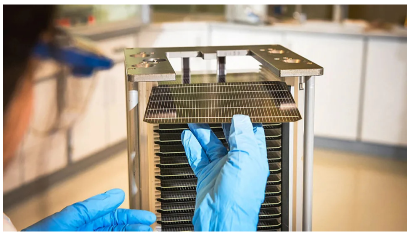
Science & technology | Sunny side up **Oct 21st 2024|OXFORD**

Perovskite crystals may represent the future of solar power



Their efficiency rates far exceed those of conventional silicon panels

IT is commonly claimed, and also true, that enough sunlight falls on Earth in the course of an hour to meet a year's worth of global power needs. Some of that sunlight is currently converted into electricity by arrays of solar panels: by the end of 2023, these panels covered almost 10,000 square kilometres of Earth's surface, producing some 1,600 terawatt-hours of electricity, about 6% of that generated worldwide.

The amount of installed solar-capacity has been doubling roughly every three years. This is happening as the silicon-based solar cells used in the panels have been getting cheaper with intense competition among firms in China, which with state support have come to dominate the industry. At the same time, researchers have found ways to make the cells better at absorbing the energy in sunlight. Modern solar panels operate with efficiency rates of 22-24%—a massive increase from the 6% achieved when the first practical solar cells were invented in the 1950s at Bell Labs in New Jersey, and were so expensive they mostly powered satellites.

Yet most processes have their limits. The maximum theoretical efficiency of a silicon solar cell—the amount of energy in sunlight that is turned into electricity—is around 29%. This is possible only in laboratory conditions. When cells are packed together into solar panels, the total efficiency of the panel is unlikely to get above 26%. This is partly because the spaces between cells and other parts of the panel, such as the frame, do not contribute to making electricity. There are also inevitable losses of energy in the wires connecting the cells.

The future of solar power, however, could lie in a new, more efficient, type of solar cell that has just gone into production. Made with a family of crystalline materials called perovskites, they are capable of delivering panels with practical efficiency rates well above 30%.

Even though their light-absorbing superpowers have been known for some time, they have been difficult to harness, not least because perovskites degrade quickly and can be susceptible to moisture. Researchers are therefore searching for ways to make them more stable and to adapt manufacturing processes to protect the cells from the elements.

A leader in developing perovskite panels is Oxford PV, a British company. The firm has developed "tandem cells", consisting of a thin layer of perovskite placed on a bed of silicon. The idea is that the two materials working together can extract a greater amount of energy from sunlight than each could individually. To do so, the perovskite layer is tweaked to absorb light from the blue end of the spectrum while the silicon layer mops up the wavelengths at the red end, says Chris Case, the company's chief technology officer.

Other companies are also close to commercialising their versions of perovskite-on-silicon solar panels. Hanwha, a big South Korean industrial group, has invested 137bn won ($102m) in a factory to make tandem cells for its QCells range of solar panels. At lab scale, the firm says individual cells have achieved a maximum efficiency of 29.3%.

The current world record for a lab-based perovskite tandem cell is 34.6%. This was claimed in June by LONGi Green Energy Technology, a big Chinese manufacturer. It began working on mass-production for the cells in October 2023. The firm says it has also achieved 30.1% efficiency in a prototype commercial-size panel, though it has not yet announced when production will begin.

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