# Improving the efficiency of tandem solar cells

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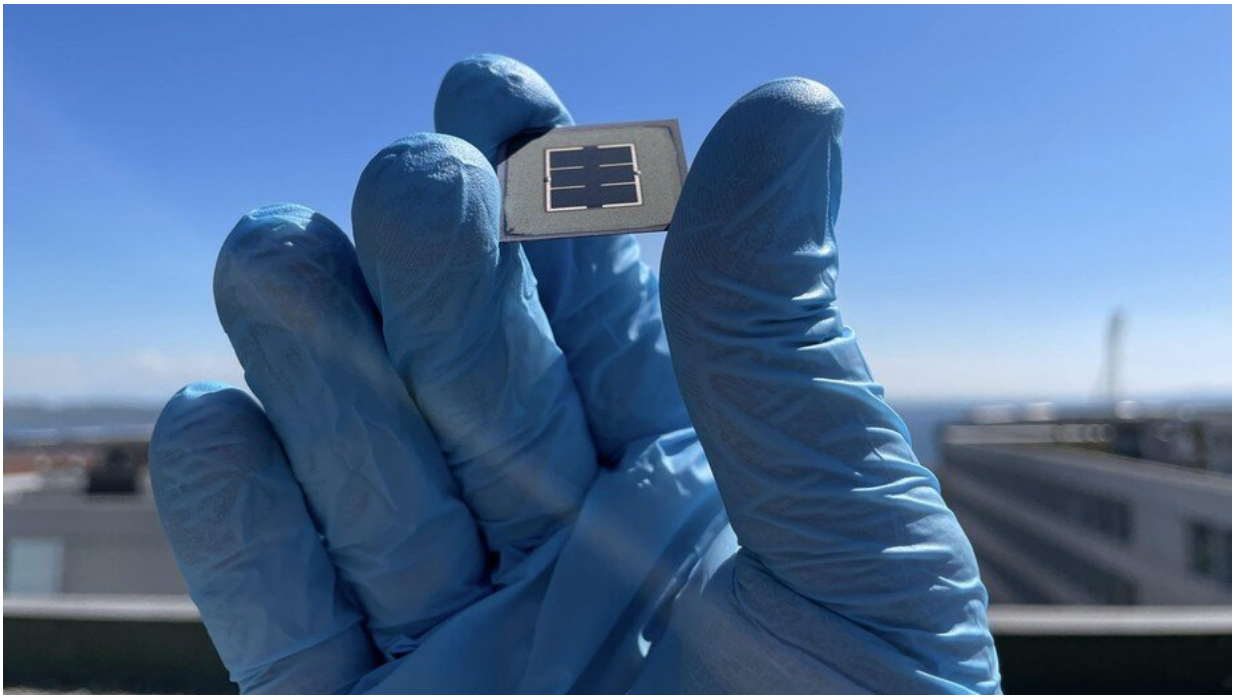

EPFL scientists in Neuchâtel have developed a tandem solar cell that can deliver a certified efficiency of 29.2%. Credit: Christian Wolff / EPFL

EPFL scientists in Neuchâtel have developed a tandem solar cell that can deliver a certified efficiency of 29.2%. This achievement was made possible by combining a perovskite solar cell with a textured silicon solar cell.

Solar cells made of silicon are used widely but have limited power-conversion yields. These yields will likely top out at around 27% in the foreseeable future, owing to fundamental thermodynamic limitations. Modules incorporating these solar cells will have maximum yields of around 23–25%.

However, these limitations can be overcome by combining silicon with a complementary solar cell that absorbs the blue-green part of the solar spectrum and employs it more efficiently, forming what's called a "tandem." Among the different materials that can be used for the tandem, halide perovskites have recently shown to be the best suited for boosting the efficiency of silicon without adding substantial fabrication costs.

One obstacle was finding a way to evenly coat the silicon surface—which is intentionally rough, or textured—with a thin film of halide perovskites. A textured surface is used in order to minimize light reflection. This kind of system can already be found in all commercially available crystalline silicon cells.

Scientists at EPFL's Photovoltaics and Thin Film Electronics Laboratory (PV-lab), led by Christophe Ballif, developed a method in 2018 to grow perovskite layers on textured silicon in a uniform manner. Their proof-of-concept devices were shown to achieve an efficiency of 25.2%. Now the researchers have enhanced the perovskite crystallization process and developed highly transparent window layers, resulting in tandem solar cells with an efficiency of 29.2% on a surface of 1 $cm^2$. This yield was certified independently by the Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE) in Germany, and sets a new world record for a fully textured perovskite-silicon device.

This is only an intermediate step, however. The research team already sees a clear path to achieving yields of beyond 30% by taking advantage

of the high current provided by the silicon texture. "Several years of R&D are still needed to bring such technology and manufacturing processes to market," says Ballif. "A big challenge will be developing solar cells that can remain stable on our rooftops for more than 25 years. But the higher efficiency we demonstrated without changing the front texture will be very attractive for the photovoltaics industry." The discovery shows high promise to cut the power generation cost per kWh, by producing more energy on the same area.

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