Turning glass into a 'transparent' light-energy harvester

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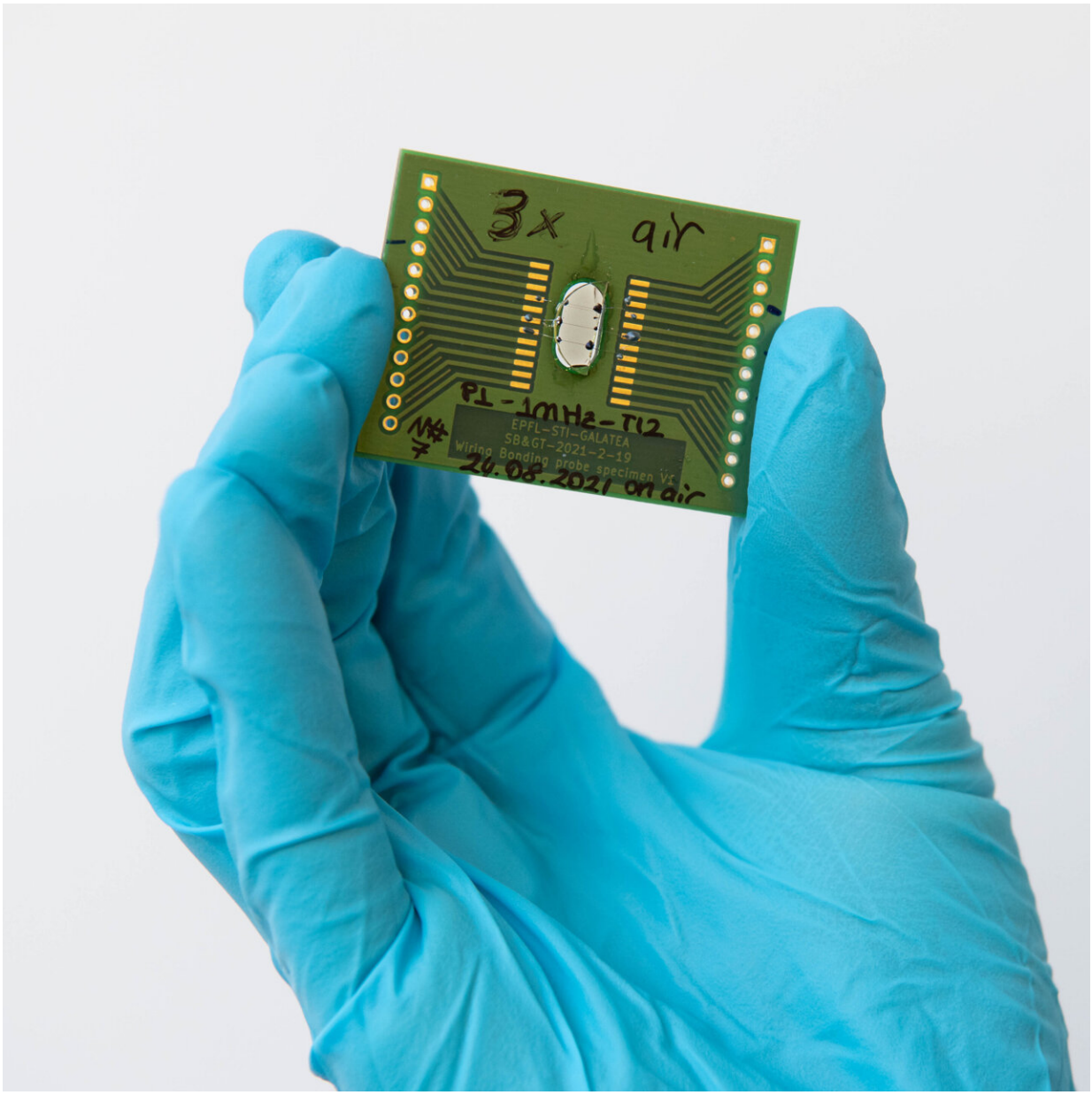

Turning tellurite glass into a 'transparent' light-energy harvester by etching semiconducting patterns using femtosecond laser light. Credit: EPFL / Lisa Ackermann

What happens when you expose tellurite glass to femtosecond laser light? That's the question that Gözden Torun at the Galatea Lab at Ecole Polytechnique Federale de Lausanne, in collaboration with Tokyo Tech scientists, aimed to answer in her thesis work when she made the discovery that may one day turn windows into single material light-harvesting and sensing devices. The results are published in *Physical Review Applied*.

Interested in how the atoms in the tellurite glass would reorganize when exposed to fast pulses of high energy femtosecond laser light, the scientists stumbled upon the formation of nanoscale tellurium and tellurium oxide crystals, both semiconducting materials etched into the glass, precisely where the glass had been exposed. That was the eureka moment for the scientists, since a semiconducting material exposed to daylight may lead to the generation of electricity.

"Tellurium being semiconducting, based on this finding we wondered if it would be possible to write durable patterns on the tellurite glass surface that could reliably induce electricity when exposed to light, and the answer is yes," explains Yves Bellouard who runs EPFL's Galatea Laboratory. "An interesting twist to the technique is that no additional materials are needed in the process. All you need is tellurite glass and a femtosecond laser to make an active photoconductive material."

Using tellurite glass produced by colleagues at Tokyo Tech, the EPFL team brought their expertise in femtosecond laser technology to modify the glass and analyze the effect of the laser. After exposing a simple line

pattern on the surface of a tellurite glass 1 cm in diameter, Torun found that it could generate a current when exposing it to UV light and the visible spectrum, and this, reliably for months.

"It's fantastic, we're locally turning glass into a semiconductor using light," says Yves Bellouard. "We're essentially transforming materials into something else, perhaps approaching the dream of the alchemist."

More information: Gözden Torun et al, Femtosecond-laser direct-write photoconductive patterns on tellurite glass, *Physical Review Applied* (2024). DOI: 10.1103/PhysRevApplied.21.014008

Provided by Ecole Polytechnique Federale de Lausanne