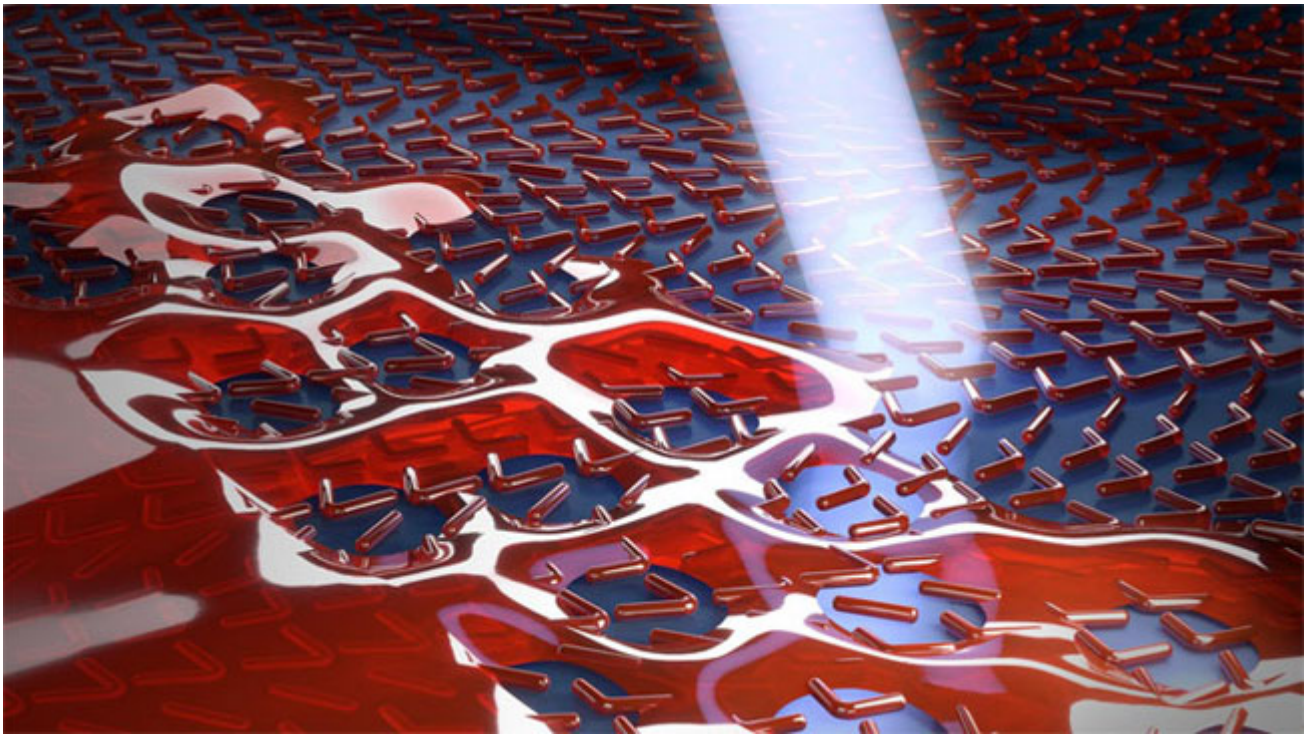
A New Way to Fabricate High-Performance Optical Metasurfaces for Use in Photonic Circuits

LAUSANNE, Switzerland, Feb. 13, 2019 – A way to produce glass metasurfaces that can be either rigid or flexible, developed by engineers from the EPFL Laboratory of Photonic Materials and Fiber Devices, could be used to fabricate all-dielectric optical metasurfaces quickly, at low temperatures, and with no need for a cleanroom. These metasurfaces could be used to build next-generation photonic circuits. Optical circuits, which are 10 to 100 times faster than electronic circuits and more energy-efficient, could transform the performance of many devices.



The new method employs dewetting, a natural process that occurs when a thin film of material is deposited on a

substrate and then heated. The heat causes the film to retract and break apart into tiny nanoparticles.

The EPFL engineers used dewetting to create dielectric glass metasurfaces, rather than metallic metasurfaces. First, they created a substrate textured with the desired architecture. Then, they deposited the material – chalcogenide glass – in thin films just tens of nanometers (nm) thick. The substrate was heated for a couple of minutes until the glass became fluid and nanoparticles began to form in the sizes and positions dictated by the substrate's texture.

The engineers demonstrated the ability to tailor the position, shape, and size of nano-objects with feature sizes below 100 nm and with interparticle distances down to 10 nm. They used their method to generate optical nanostructures over rigid and soft substrates that were several centimeters in size, with optical performance and resolution comparable to traditional lithography-based processes. The metasurfaces are highly sensitive to changes in ambient conditions, thus able to detect the presence of very low concentrations of bioparticles, the team said.

Metasurfaces could enable engineers to make flexible photonic circuits and ultrathin optics for a host of applications, ranging from flexible tablet computers to solar panels with enhanced light-absorption characteristics. They could also be used to create flexible sensors to be placed directly on a patient's skin, for example, to measure things such as pulse and blood pressure or to detect specific chemical compounds.

For more information:
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