Printing the future: Tailoring chemistry for inorganic 3D micro-optics

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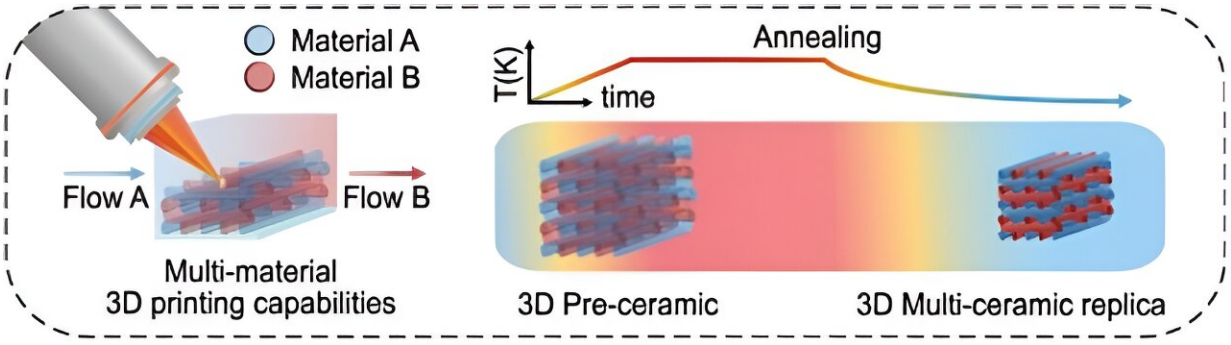

Multimaterial composition sketch representing a microfluidic cell. After printing and development, the precursor for glass/ceramic is exposed to be annealed. Credit: *Trends in Chemistry* (2024). DOI: 10.1016/j.trechm.2023.12.005

In a recent publication in the journal *Trends in Chemistry*, researchers from the University of Twente delve into the potential of 3D printing ceramics in micro-optics. These tiny ceramic structures can potentially be used to generate light and store information. "Let's make ceramics so small they can manipulate light."

As with many publications, the article began with curiosity-driven students. J.P. Winczewski (former Ph.D.), J. Arriaga-Dávila (Nanotechnology master), and C. Rosero-Arias (Ph.D.) dove into 3D printing ceramics beyond our eyesight. "Instead of printing something

massive, we decided to go the other way around and make extremely small printed structures," says Arturo Susarrey-Arce, assistant professor at the Mesoscale Chemical Systems research group of the University of Twente.

Ceramics are very powerful in the micro-optics field due to their light-matter interaction properties. The speed of light in a vacuum is known to be unbeatably fast. However, glass and ceramics have a higher refractive index, meaning light gets slowed down while propagating through the suitable material. "Looking at the future, 3D-architected ceramics can contribute to optical communication and light circuits with the right material combination and composition," says Susarrey-Arce.

As the name suggests, 3D printing implies accurately shaping micro-optics in all three dimensions. "Miniaturization typically occurs in 2D, but there is still much space in the third dimension," explains Susarrey-Arce. However, to advance, there are still challenges to overcome. For example, 3D ceramic printing should comply with key characteristics.

To integrate 3D ceramic printing into low-temperature micro-optics, the researchers have to achieve perfect microarchitectures at the highest spatial precision. This aspect partially relies on the availability of various resins that change their properties when exposed to light, permitting them to print them simultaneously. Developing such resins remains a challenge for synthetic chemists, a challenge we engage daily in the lab.

More information: J.P. Winczewski et al, Tailoring chemistry for inorganic 3D micro-optics, *Trends in Chemistry* (2024). DOI: 10.1016/j.trechm.2023.12.005

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