Realizing direct lithography of composition-tunable perovskite NCs inside of glass

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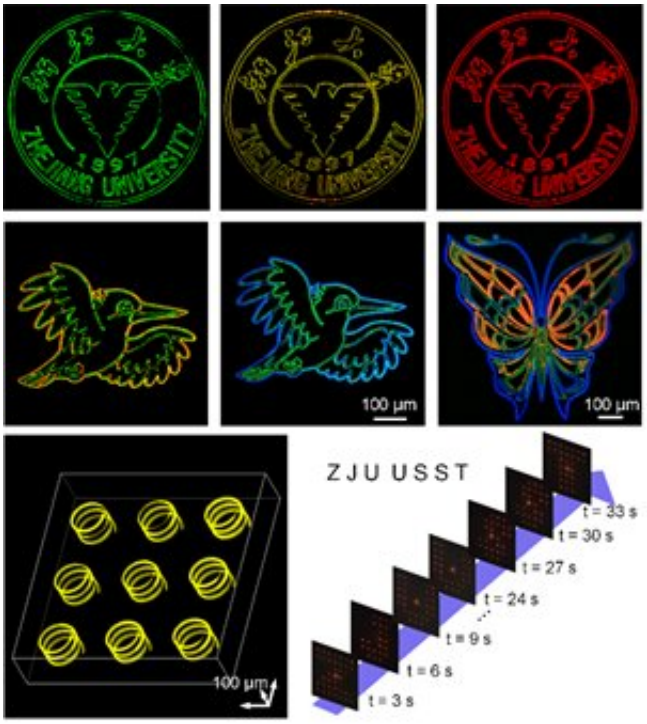

Credit: LU Shaoqing

A team of researchers affiliated with a large number of institutions in China has realized direct lithography of composition-tunable perovskite nanocrystals inside of glass. In their paper published in the journal *Science*, the group describes their experiments that involved direct lithography of colored perovskite nanocrystals (PNCs) resulting in desired patterns.

Perovskites are a type of mineral that has certain desirable characteristics, such as optical properties that make them useful for the creation of fuel cells and electronic devices, such as cathodes and LEDs. But, as the researchers note, processing the minerals typically involves the use of special solutions, which they further note leads to low structural stability. They also note that recent prior work with incorporating NCs into glass has been used to gain photonic functionality from the minerals but it has been challenging to pull off. In this new effort, the researchers have developed a new approach—using ultrafast laser pulses to conduct 3D direct lithography of composition-tunable perovskite NCs. In their approach, a laser was used to heat the glass which also increased pressure—the result was liquid nanophase separation.

The researchers used oxide glasses made of lead, cesium and halide which had been processed to remove impurities. They then used a trial-and-error approach to fine tune the laser as it induced a structure inside of the glass sample. They then used the laser to etch 3D patterns into the glass. Initial attempts involved etching pixel dots with different emission wavelengths, demonstrating the possibility of using the technique for making micrometer sized LEDs. The researchers followed that up by etching three dimensional colored patterns which included images of letters, numbers and symbols. They also etched multicolored arrays to demonstrate the possibility of using their technique to create glass-based memory devices.

The researchers note that the etching process can be modified by altering the timing of the pulse laser. They also note that the process can be used to create materials for use in optical applications by etching patterns with desired wavelength tuning. They also point out that the products produced are far more stable than those used with solution etching —even when exposed to temperature fluctuations or other environmental conditions.

More information: Ke Sun et al, Three-dimensional direct lithography of stable perovskite nanocrystals in glass, *Science* (2022). DOI: 10.1126/science.abj2691