Because the experiment was limited by shot noise that is in turn determined by the photon flux, the mass resolution depends on the molecular mass and can be expressed as a fraction of the molecular mass. Remarkably, it was even possible to detect the binding of small ligands to a protein due to the impressive mass precision of 1.8%.

Additionally, iSCAMS can monitor the mass change of a single biomolecular complex in real time, which is impossible in conventional mass spectrometry. The researchers analysed the assembly process of several proteins, for example, alpha-synuclein, a key player in Parkinson's disease, and actin, a major component of the cytoskeleton. Such capabilities will potentially provide insight into mechanisms of neurodegenerative diseases and other cellular processes.

This work by Young et al. represents the first optical mass imaging technique that can quantitatively measure the mass of single biological macromolecules in ambient conditions. Because this study used non-specific binding of molecules to a clean coverslip, it does not provide molecular specificity. It will be challenging to analyse complex samples such as cell lysates because other biomolecules will adhere to the surface. However, these limitations might be overcome by passivating the surface and functionalizing it with antibodies to capture specific molecules of interest[9]. By combining iSCAMS with sensitive fluorescence detection, it should be possible to investigate the conformational changes of molecular machinery during self-assembly. Sub-shot-noise measurements using correlated light[10] may be able to further improve the precision of the mass measurement to below a few kDa so that a drug binding to biomolecules or small chemical modifications can be identified. ❐

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Published online: 28 June 2018
https://doi.org/10.1038/s41566-018-0202-8

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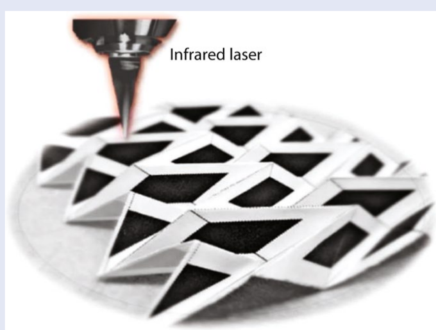
LASER FABRICATION

Paper electronics

Laser-based fabrication schemes underpin the manufacture of a diverse range of devices spanning from large car parts to tiny biomedical stents. Now research performed by scientists from the USA and China suggests that lasers could help realize 3D foldable electronics on paper (see image). Xining Zang and co-workers from the University of California Berkeley, Tsinghua Berkeley Shenzhen Institute and the US Army's research centre at Redstone Arsenal have developed a direct-write laser patterning process that creates electrically conductive molybdenum carbide–graphene (MCG) regions on paper (*Adv. Mater.* https://doi.org/10.1002/adma.201800062; 2018). The laser writing was carried out under ambient conditions. The paper is first sprayed with a gelatin ink containing Mo^{5+} ions and then a beam from a 10.6-μm CO_2 laser is scanned over the paper in the desired pattern to create black conductive regions that can serve as electrodes or electrical tracks. The power of the writing laser was 2 W and the writing speed was 200 mm s^{-1}. Raman and X-ray diffraction results of the samples reveal the existence of both Mo_3C_2 and graphene after the laser writing. The sheet resistance of the laser-irradiated regions was 51.3 Ω per square, which is lower than that obtained when water-soluble polymers were used instead of gelatin.



Credit: Wiley

Interestingly, spring2018@DE!thicker papers can absorb and hold more ink and thus make it possible to achieve lower sheet resistance after the laser writing. Commercial copy paper was found to have both good mechanical strength and low sheet resistance. Tests indicate that the MCG regions on the paper were resilient to repeated 180° folding operations. The first 50 folding operations generally induced a 13% decrease in conductivity, but the conductivity was maintained with less than 5% decay in the following 750 cycles. The team foresee a myriad of potential applications for their conductive paper, including its use in electrochemical ion detectors and gas sensors, 3D piezoelectric generators, and supercapacitor electrodes. ❐

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Published online: 28 June 2018
https://doi.org/10.1038/s41566-018-0206-4