One clear drawback of the technique is that the photodetection scheme demonstrated in the first device is unlikely (in its current form) to be practical for use in an optical network. The extremely large optical loss and potentially severe coupling loss resulting from modal mismatch at a junction with a conventional step-index fibre, together with the presence of an end-face electrode, excludes the device from practical applications in optical circuitry. The researchers point out that the second device is more appropriate for connecting to a single-mode fibre, but they have not yet demonstrated photodetection in this structure. Although He *et al.* suggest the possibility of implementing sidewise electrodes, they do not describe a method for doing so.

Research in this area must now address serious application-related issues such as coupling losses and practical fabrication and implementation of electrodes. The ability to integrate important network components such as lasers, detectors, sensors and modulators into an optical fibre is an ambitious but worthwhile goal that has the potential to change optical networks significantly. The report of future in-fibre devices with different functionalities is eagerly anticipated. ❒

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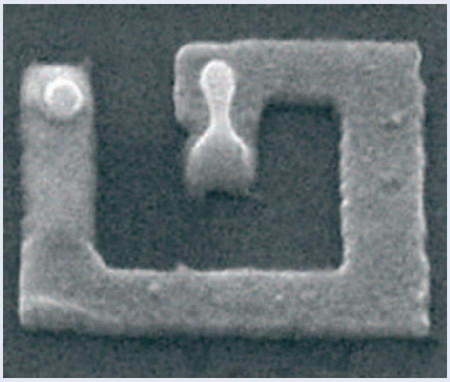
PLASMONIC ABLATION

Moulding metals

Light can melt metal if its intensity is high enough, which can be achieved, for example, through high laser power, tight focusing, short pulse length or strong optical resonance. During this molten state the metal can be reshaped by a number of physical effects, such as electromagnetic forces, surface tension and thermal effects, after which rapid cooling permanently sets the new structure (pictured). In their recent report, Ventsislav Valev and colleagues from Beligum, Russia, Germany, Singapore, Bulgaria and the UK report on the mechanisms involved when melting metals with plasmonic laser ablation (*Adv. Mater.* http://dx.doi.org/10.1002/adma.201103807; 2012). The researchers illuminated G- and star-shaped gold and nickel nanostructures with 120 fs, 800 nm pulses from a Ti:sapphire laser focused to a spot size of around 330 nm × 440 nm.

According to Valev, the researchers previously believed that high laser powers would cause the nanostructures to melt into spherical shapes, under the influence of surface tension. This follows from the assumption that heating is approximately homogeneous. However, this assumption is incorrect, according to Valev, and heating can be much stronger than expected in the plasmonic hotspots.

"Within plasmonic hotspots, the charges are driven very strongly by the electric field. These oscillating charges constitute local electric currents that locally heat up the material — the plasmonic hotspots can become very hot indeed," Valev told *Nature Photonics*. "As a consequence, our laser beam starts by melting the nanostructures precisely in the plasmonic hotspots and creates tiny pools of melted gold therein. Within these pools, hydrodynamic processes can take place, such as the nanojets seen in our images."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However, Valev explained that this mechanism is only part of the story. Within the plasmonic hotspots, the electrons are initially driven in the linear regime. As the laser intensity is increased, the electrons start being driven in the nonlinear regime. At this point, second-harmonic light is generated at the plasmonic hotspots, which allows the hotspots to act as individual light sources. Because the second-harmonic light is at a different frequency to the fundamental illumination wavelength, there is no need for complicated demodulation or imaging techniques. This second-harmonic light, which can be directly imaged using a confocal microscope, provides the first approximation for mapping the plasmons.

The researchers claim that the resulting plasmonic nanopatterns are smaller than those produced through conventional optical techniques, although they have yet to quantify the resolution. Valev explained that the approach is capable of clearly resolving two hotspots in a 200 nm × 200 nm area, which is the smallest nanostructure the team has tried imaging so far. However, the real advantage of the technique may be in its speed, for applications such as the mapping of electromagnetic response on nanostructures.

The researchers hope to popularize their method. Valev explained that their technique holds great potential as it requires only a standard confocal microscope. Such microscopes are commonly available in biology labs, yet many scientists don't seem to be aware of their potential use for imaging plasmonic nanostructures.

"We will be investigating other geometries and materials. We will also devote special attention to numerical simulations of the hydrodynamic processes involved," explained Valev. "We are also keeping our eyes open for potential applications, such as plasmon-assisted subwavelength laser ablation for fabricating nanoparticles with nearly perfect spherical shapes."

DAVID PILE