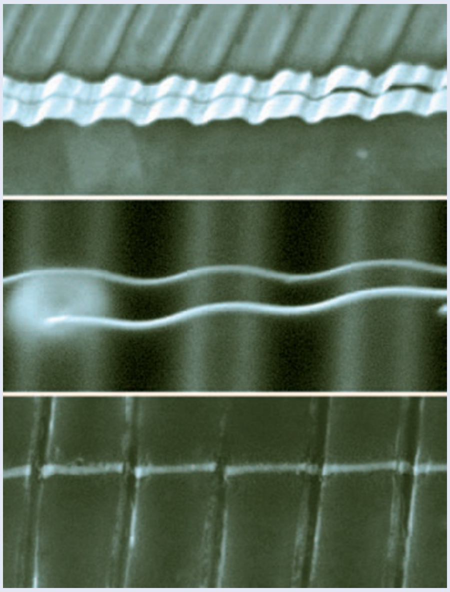
LASER NANOFABRICATION

New regimes for nanoshaping

The peculiar optical, electronic and mechanical properties of nanowires (NWs) have generated intense scientific and technological interest over the past few decades. The properties of a NW can be tuned through post-processing techniques such as bending, buckling, cutting and shaping, thus providing control over functions such as strain engineering, electronic transport, mechanical properties, band structure and quantum properties. However, today's techniques for shaping NWs are limited in their scalability. Although atomic force microscopy tips can be used to hold and bend NWs, generating complex shapes is difficult because NWs must be treated one-by-one.

Ji Li and colleagues from Purdue University in the USA have now developed a laser-shock-based technique for shaping NWs in a scalable and controllable manner (*Nano Lett.* **12,** 3224–3230; 2012). The target in their study was comprised of a glass confinement layer, a graphite ablative coating layer, an ultrathin metal foil, an elastomeric material layer, aligned silver NWs and a silicon nanomould. They used a vapour–liquid–solid process to synthesize the NWs, which were single crystals with diameters of around 100 nm.



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Irradiating the target with 5 ns laser pulses at intensities of 0.07–0.2 GW cm^{-2} caused the ablative coating to vapourize into a plasma. The expanding plasma bounced off the confining media to generate a strong shock pressure of 600–1,000 MPa, which was sufficient to shape the metal foil — and thus the underlying NWs — onto the mould.

By adjusting process conditions such as the laser intensity, substrate material and mould shape, the researchers successfully demonstrated the conformal shaping, uniform bending and cutting of silver NWs. For conformal shaping, the typical feature size was 80 nm and the depth was 60 nm. According to the researchers, lateral compression should also be possible by placing silver NWs onto a mould with a flat surface.

Li *et al.* also investigated the microstructure evolution of laterally compressed silver NWs by transmission electron microscopy. They found that a high density of deformation twins formed at the surface of the NWs and then moved inside after compression. This 'coherent boundary' has a small influence on electrical resistivity. The observation of twins supports the negligible change in electrical property of silver NWs before and after laser-shock-based forming.

The researchers say that their technique operates at room temperature and atmospheric pressure, and can be used with various materials, including semiconductors such as silicon and germanium.

NORIAKI HORIUCHI

VIEW FROM... CLEO 2012

Celebrating semiconductor lasers

Over the past five decades, breakthroughs in device design and advances in material and growth technologies have transformed semiconductor lasers from laboratory curiosities into practical devices with real-world applications.

Rachel Won

In 1962, the discovery of the semiconductor laser was hailed as a breakthrough that would revolutionize entire industries. Indeed, the impact of this device is clear from its wide range of applications, which include fibre-optic communications, materials processing, manufacturing technologies, printing and optical data storage, to name just a few. This year's Conference on Lasers and Electro-Optics (CLEO) in San Jose, California, USA, held a special symposium to celebrate the fiftieth anniversary of semiconductor lasers, with talks covering a variety of semiconductor laser technologies.

Nanolasers, double-heterojunction (DH), distributed feedback (DFB) and quantum dot (QD) lasers were among the reported technologies that differ from the simple p–n junction concept. *Nature Photonics* interviewed a number of experts in these areas to give a better picture of how each technology has developed over the course of its lifetime, covering recent advances, current challenges and future outlook.

"Semiconductor lasers are by far the preferred light sources for communication applications," said Amnon Yariv from the California Institute of Technology in the USA. "They are structurally similar to transistors in many ways, which enables them to interface naturally with transistor circuitries. They are fast, responding to