lasers and carbon dioxide lasers used in manufacturing, thanks to their smaller size, better beam quality, lower power consumption, higher reliability and lower operating costs. Heinz Huber, a professor for laser technology and photonics at the Münich University of Applied Science and a consultant for High Q Laser/Spectra Physics, a division of Newport (Irvine, California, USA), says that "fibre lasers are beating lamp-pumped and carbon dioxide lasers in almost every discipline."

Another notable type of laser technology, explains Huber, is the ultrafast laser, which delivers large amounts of energy over extremely short pico- or femtosecond durations. Such short, high-energy pulses allow the precise machining of sensitive electronics by affecting only the target area while leaving adjacent material undamaged. Glass can be cut without leaving microfractures, and tiny holes can be drilled through computer chips or other components. Huber says that femtosecond laser technology has a proven track record and has seen dramatic reductions in price over the past few years. This technology could spread even further as costs come down. Approval from the US government for the use of femtosecond lasers in cataract surgery could provide another boost, although medical applications still represent only a small percentage of the market.

Photolithography for semiconductor manufacturing accounts for around 11% of the laser market. The market for such multi-million-dollar excimer lasers is cyclical, explains Hausken, as chip-makers move between standards for the sizes of transistors. "The market was on a decline for two or three years, but now it's on an upswing," he says.

Industrial lasers account for around 40% of the market. Another 31% comprises data and telecommunications lasers, which demand high volume at low cost and represent a very competitive area. The telecommunications industry, which faces continual demands for higher bandwidths, is currently in the process of installing 40 Gbit s^{-1} transmitters while moving rapidly towards 100 Gbit s^{-1} systems.

David Welch, chief strategy officer at Infinera (Sunnyvale, California, USA), a manufacturer of integrated wavelength-division multiplexing components for telecommunications, says his company is currently introducing a 500 Gbit s^{-1} device. At this point, he explains, it makes more sense to talk about a system's bandwidth than the number of lasers it contains, just as in computing it makes more sense to talk about overall chip speed rather than the number of individual transistors. "It's about selling the laser as a portion of a system or a subsystem," he says. The same tablets and smartphones that require lasers for manufacturing also require telecommunications lasers to handle the data traffic they generate. "The bandwidth demands are insatiable, and this trend will continue for some time," Welch says.

Hausken explains that applications such as military, scientific, medical, sensors, instrumentation and image recording each account for only single-digit percentages of the market, and therefore don't cause dramatic changes in overall sales figures.

The outlook for 2012 is relatively flat, in part due to continued uncertainty about Europe's economy. "2012 is an uncertain year," Hausken says. "It's not going to be especially good, but it's not going to be especially bad."

Hausken predicts that the dip that occurred in the second half of 2011 will be over by mid-2012. However, Strategies Unlimited projects that the pace will pick up in 2013, eventually bringing the market to US$9.4 billion by 2015. "The market is back to steady but moderate growth," he says. ❐

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NANOWIRE PHOTONICS

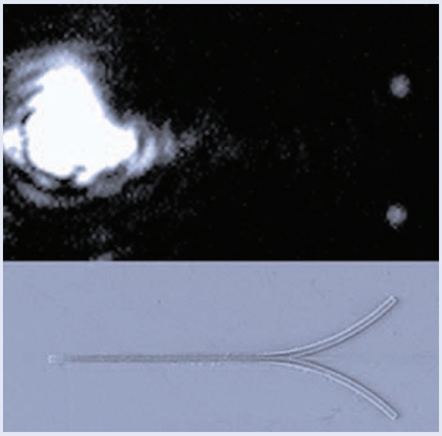
Investigating plasmonic damping

The ability of plasmonic nanowires to confine and guide light at a subwavelength scale gives them wide appeal for use as optical sensors and nanoscale building blocks in photonic integrated circuits. Although combining many individual nanowires could enable plasmonic routing for the development of logic networks, damping unfortunately limits the propagation of surface plasmons.

To gain a better understanding of the loss mechanism involved, Primoz Kusar and colleagues from Karl Franzens University in Austria used scattered light spectroscopy to investigate the relative damping contributions from metal crystallinity and substrate absorption (*Nano Lett.* **12,** 661–665; 2012). The researchers studied chemically synthesized single-crystalline silver nanowires with diameters of around 90 nm and lengths of up to 40 μm, as well as lithographically fabricated polycrystalline silver and gold nanowires spin-coated on either quartz or indium tin oxide-covered glass substrates with cross sections of 100 nm × 75 nm.

By analysing the nanowires' spectral signatures — interference resulting from multiple surface-plasmon reflection in the Fabry–Pérot longitudinal cavity modes — the researchers were able to deduce the spectral-dependent damping of the surface-plasmon modes and thus reconstruct the surface-plasmon dispersion. They found the strongest modulation contrast occurred for single-crystalline nanowires on quartz, indicating not only that non-absorbing substrates exhibit low damping, but also that damping increases with nanowire length. They also found that absorption is the dominant factor in determining the short propagation length of surface plasmons in nanowires on indium tin oxide-covered glass substrates.

The researchers then fabricated surface-plasmon splitters by dividing the ends of silver and gold polycrystalline nanowires in two. They concluded that polycrystalline nanowires, which were previously expected to exhibit strong damping due to scattering at grain boundaries, can be used for nanowire networks. This finding certainly broadens the potential of nanoscale plasmonic routing.



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