SLOW LIGHT

On-chip pulse compression

Phys. Rev. A **91,** 023831 (2015)

A chip-based temporal compressor for shortening the duration of optical pulses has been developed by scientists in Japan. The scientists at Yokohama National University made their compressor from a silicon photonic crystal waveguide. Co-propagating slow light is used as a control pulse and serves to induce carrier plasma dispersion in the waveguide through two-photon absorption. The efficiency of the effect is greatly enhanced due to the control pulse propagating in the slow-light regime. The induced dispersion is used to spectrally broaden or 'chirp' a signal pulse. Dispersion compensation, invoked by a series of seven pairs of integrated heaters spaced along the length of the waveguide, is then used to compress the pulse. Using the scheme, the team report compressing a 13.9 ps input pulse down to a duration of 1.4 ps, corresponding to a compression factor of 9.9. *OG*

PLASMONICS

Recipe for success

ACS Photon. http://doi.org/2q7 (2015)

Although the use of high-quality metal films will not solve the loss issue for plasmonics, it can be a substantial improvement if the metal is deposited in a certain way. Kevin McPeak and colleagues at ETH Zurich, Switzerland, have created a cookbook for reproducibly making high-quality Ag, Au, Cu and Al metal films for plasmonics with optical performance that is much better than standard references. They focused on the commonly available thermal evaporation technique so that the majority of researchers can benefit from their work. McPeak *et al.* detailed every step of the process, determined the optimal deposition conditions and measured optical performance. They reveal a real part of the permittivity that is similar to standard references but with imaginary (loss-related) parts that are significantly smaller. Quality factors for localized resonance and standard propagation on Ag are improved by 200% and 250%, respectively, at a wavelength of 650 nm. The team highlights that fast deposition is often advantageous for achieving larger grain sizes as it gives less time for reaction with residual gases in the chamber. Larger grain means less scattering due to less boundaries. *DP*

METAMATERIALS

Anomalous reflection

Nano Lett. **15,** 1615–1621 (2015)

When a laser hits a flat surface the beam is usually reflected at an angle equal to the angle of incidence. However, in the case of reflection from a metamaterial, the presence of subwavelength resonators on the surface can impart phase gradients and cause 'anomalous' reflection at other angles. Such effects have been observed in near-infrared or longer wavelength regions but, due to the difficulty of fabricating subwavelength features for visible light operation, demonstrations have been lacking at shorter wavelengths. Zhongyang Li and colleagues at Northwestern University, Illinois, USA, have now demonstrated anomalous reflection of light with wavelengths from 450 to 850 nm. To achieve this they designed a relatively simple system based on an array of nanorods of varying widths, that is, a trapezoid. The 800-nm-long metal resonators vary in width from 30 nm to 150 nm. This is different to many other attempts that used more complicated arrays with parameter gradients across multiple unit cells; here all of the resonators in the array are identical. The efficiency of the anomalous reflection is high and estimated to be approximately 1,000 times stronger than the efficiency of scattering into the first diffraction order. A similar redirection of light into desired angles by 'flat' surfaces can be achieved with structures like blazed gratings but the metasurfaces demonstrated by Li *et al.* offer broadband operation compared with those concepts that are inherently narrowband. Li *et al.* note that the idea could lead to high signal-to-noise ratio optical spectrometers, polarization beamsplitters, directional emitters, and spectrum-splitting surfaces for photovoltaics. *DP*

LASERS

CEP stable laser

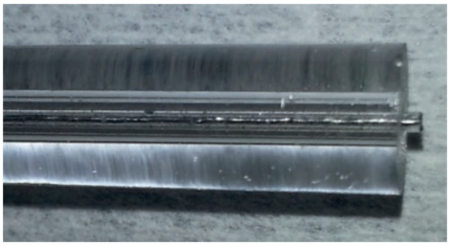
Opt. Express **23,** 4563–4572 (2015)

The realization of high-energy, sub-cycle waveforms for potential applications such as arbitrary waveform generation and quantum control requires a laser with a stable carrier-envelope-phase (CEP). However, there is a trade-off between the pulse energy and the CEP stability. Benjamin Langdon and co-workers from the USA and Germany have now reported a CEP-stable terawatt Ti:Sapphire laser. The system consists of a pumped Ti:Sapphire oscillator that feeds a chirped pulse amplification scheme consisting of two amplification stages. The CEP noise at the output was measured by an f–2f interferometer that was also used to drive an error signal for feedback correction. As the CEP noise mainly originates from the pulse stretcher and compressor used within the amplification scheme, they were mounted on special floated platforms to reduce vibration. Using this mounting method, mechanical vibration and CEP noise was significantly attenuated. The result was a 0.77 TW (20 mJ pulse energy, 26 fs pulse duration, 1 kHz repetition rate) laser with a CEP stability of 300 mrad over 9 hours. This laser was also used to pump a white-light-seeded optical parametric amplifier. Due to the preservation of the CEP stability in the white-light generated signal and the passive CEP stability in the idler, this laser system promises synthesized laser pulses spanning multi-octaves of bandwidth at an unprecedented energy scale. *NH*

OPTICAL FIBRES

Silicon–silica integration

Nature Commun. **6,** 6248 (2015)



NPG

A Singapore/USA research collaboration has developed a technique to fabricate metre-long fibres with a crystalline silicon core and a silica glass cladding. Such fibres may in the future offer a means for integrating silicon-based electronics and glass-based photonics functionality. The fibre is made by inserting an aluminium rod into a silica tube preform (pictured) which is then thermally drawn to create a fibre. The high temperature (2,200 °C) of the drawing process causes the aluminium to chemically react with the cladding silica and reduce to form silicon. Electron microscopy and X-ray spectroscopy of the fibre confirm that the conversion to silicon has taken place and that the core is of high quality. Electrical characterization of the silicon core reveals that it has a resistivity of 0.3 Ω cm. The team from MIT and Nanyang Technological University and the National University of Singapore are now considering how to apply the technique to fabricate nanoscale silicon wires. *OG*

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