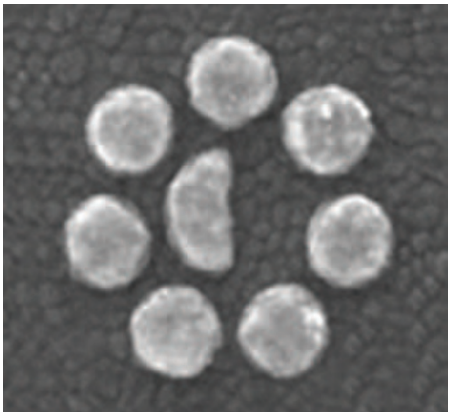
NANOPHOTONICS

Switching resonances

Nano Lett. **12,** 4977 (2012)



Clusters of metallic nanoparticles are known to be able to support complex optical Fano resonances as a result of interactions between multiple modes. Now Wei-Shun Chang and colleagues from Rice University, USA have shown a simple way of switching between optical responses of different polarizations simply by turning on a voltage of 6 V. The team fabricated a ring (several hundred nanometres in diameter) composed of seven gold disks, each about 30 nm in size. An eighth larger and semicircular-shaped disk is located inside the ring and introduces structural and polarization asymmetry. For one polarization the authors report an optical Fano resonance with two peaks (at red and near-infrared wavelengths), whereas for another polarization a simple single-peak resonance (red wavelength) is observed. However, by embedding the system in a liquid crystal and applying a voltage of about 6 V (alternating at a frequency of 1 kHz), the transition from a homogeneous nematic phase to a twisted phase can be induced, and the polarization rotated by 90°. As a result, the authors were able to use the voltage to switch the Fano resonance reversibly off for one polarization and on for another. *DP*

OPTICAL MATERIALS

Upconversion nanocrystals

Appl. Phys. Express **5,** 092601 (2012)

Lanthanide-doped nanocrystals that can efficiently upconvert infrared radiation into visible light are being studied with a view to applying them in the display, DNA-detection and bio-imaging areas. Now Xiaojie Xue and co-workers from the Toyota Technological Institute, Japan have observed ultraviolet emission from Tb^{3+}/Yb^{3+}-codoped KY_3F_{10} nanocrystals that were excited with light from a 976-nm laser diode. KY_3F_{10} nanocrystals doped with *x*% Tb^{3+} and 5% Yb^{3+} were synthesized by a hydrothermal method and had an average size of about 45 nm. The emission spectrum of the nanocrystals featured both strong ultraviolet emission at 381 nm and weaker green emission at 544 nm. The emission decay time for the ultraviolet emission was 1.9 ms. The intensity ratio between the ultraviolet–blue emission from the $^5D_3$ level and the green emission from the $^5D_4$ level decreased with increasing Tb^{3+} concentration. The researchers say that this concentration-dependent phenomenon is evidence of cross-relaxation, and indicates possible upconversion mechanisms based on the energy transfer from Yb^{3+} to Tb^{3+} and cross-relaxation processes between Tb^{3+} pairs. *NH*

SILICON PHOTONICS

Amorphous alternative

J. Eur. Opt. Soc. Rap. Publ. **7,** 12033 (2012)

Silicon photonic devices are usually constructed from crystalline silicon owing to its high material quality and low optical absorption in the near- and mid-infrared, but scientists in Germany have now shown that a wide variety of low-loss passive devices can be made using thin films of hydrogenated amorphous silicon. Timo Lipka and co-workers from Hamburg University of Technology successfully fabricated waveguides, power-splitters, tapers, ring resonators and Mach–Zehnder interferometers using plasma-enhanced chemical vapour deposition. The researchers say that a low defect density was achieved by using a moderate deposition temperature of between 250 and 300 °C. Thin films of amorphous silicon were deposited onto substrates made from a variety of materials including Pyrex, BK-7 glass and silicon-dioxide-covered silicon wafers. Measurements indicate that at a wavelength of 1,550 nm, hydrogenated amorphous silicon rib waveguides had an average propagation loss of ~2 dB cm^{-1}, with the best devices reaching ~1 dB cm^{-1}. In addition, ring resonators with a 10-micrometre radius were demonstrated to have a *Q*-factor of up to 7,500, and 50:50 power-splitters were used to create Mach–Zehnder interferometers with interference fringes up to 25 dB deep. In the future, it is thought that such a-Si:H devices may suit on-chip integration and prove useful for applications in telecommunications and sensing. *OG*

NANO-OPTICS

Ultrafast antenna switch

N. J. Phys. **14,** 093005 (2012)

Optical nano-antennas allow the manipulation of optical fields at the subwavelength scale, providing control over the direction of emitted light that can be of benefit in many applications including sensing and solar cells. Now a theoretical study from Roman Noskov and colleagues from Russia and Australia has shed light on a hybrid metal–dielectric nano-antenna that allows for dynamic control over its scattering pattern. In particular, the radiation pattern can be reversed by varying the external field intensity, offering potential for ultrafast all-optical switching. The hybrid system consists of nanoparticles made of silver, chosen for its relatively low loss and high nonlinear susceptibility, and crystalline silicon, which is a high-permittivity dielectric. The intrinsic nonlinearities of the silver particles lead to different polarizabilities of the metal and dielectric nanoparticles. This in turn imparts a phase shift between the dipole moments of the nanoparticles, resulting in the ability to switch between the forward and backward directions of the radiation pattern. Numerical simulations by the researchers reveal that the system possesses a switching time of just 40 fs. Comparing this with present switching times, of a few picoseconds, this hybrid seems to be an ultrafast alternative. *SA*

CHIRPED PULSE AMPLIFICATION

Similariton seeding

J. Opt. Soc. Am. B **29,** 2270–2274 (2012)

Chirped pulse amplification, a process often used to increase the pulse energy from a fibre oscillator, suffers from large spectral modulation and pedestal generation when it is seeded by solitons. Although similaritons, which are self-similarly evolving pulses, are a good candidate seed owing to their linear chirp, chirped pulse amplification seeded by similaritons has not been demonstrated before at the telecommunications wavelength of 1,550 nm. Junsong Peng and colleagues from Shanghai Jiao Tong University in China have now experimentally demonstrated an all-fibre, similariton-seeded amplification and compression system at this wavelength. Similaritons were first generated in a dispersion-managed ring cavity made of a 130-cm-long erbium-doped fibre and with a net dispersion of 0.021 ps^2. They were then passed through an erbium-doped fibre amplifier that provided gain and further stretched the similaritons to avoid nonlinear effects during amplification.