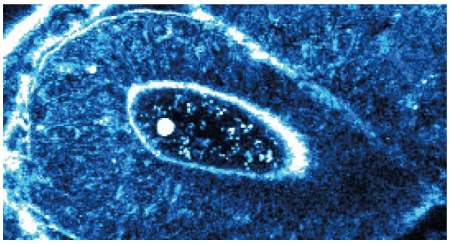
MICROSCOPY

Fast polarization sensitivity

Optica **6**, 385–388 (2019)



Credit: The Optical Society

While it is known that third-harmonic generation (THG) microscopy can probe birefringence and molecular ordering, thanks to its inherent polarization sensitivity, this feature has now been exploited for live biological imaging applications as the technique's response time is slow. Now, Joséphine Morizet and colleagues from France have come out with a fast polarization-resolved THG microscope (P-THG) that offers temporal resolution in the 10-ms range. They use an electro-optic modulator to switch the excitation polarization within 12 μs between every line scan and developed a fit-free methodology based on the calculation of the Fourier components of P-THG signals. To prove that their approach is feasible, the team carried out measurements on molecular ordering in deforming lipid structures, in vivo detection of the anisotropy of flowing microparticles in the zebrafish's inner ear, and one-shot detection of birefringence from ordered lipids and biocrystals in live organisms. *RW*

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NANOPHOTONICS

Broadband UV source

ACS Photon. https://doi.org/c35s (2019)

A miniature broadband deep-ultraviolet light source that emits from 240 to 300 nm has been demonstrated by scientists in Germany and the United States. Liping Shi and colleagues make use of third-harmonic generation (THG) in rectangular nanoholes in a gold film. Localized surface plasmon modes in the holes were excited by a broadband Ti:sapphire oscillator emitting ultrashort pulses centred at 825 nm wavelength. The plasmon resonances not only boost the third-harmonic intensity, but also enable it to be broadened to a spectral width of 60 nm. The structure consisted of 290 nm × 140 nm apertures in a 250-nm-thick Au film on 15-nm silicon nitride, arrayed with 42-nm period over a 50 × 50 μm^2 area. Plasmonic resonances at ~760 nm and ~820 nm wavelength were identified as being responsible for the efficient widening of the response. The THG conversion efficiency is of the order of 10^{-9} and third-harmonic output is elliptically polarized. *DFPP*

https://doi.org/10.1038/s41566-019-0430-6

METAMATERIALS

New negative index

Appl. Phys. Lett. **114**, 111101 (2019)

Negative-index media are typically made by introducing simultaneous negative permittivity and negative permeability to a system. Now, Simon Yves and co-workers in France claim to have demonstrated a negative-index metamaterial medium that they say is based on just negative effective permittivity and unit cells of resonator pairs supporting a dipolar resonance. The experiments were conducted in the microwave regime at ~4.7 GHz wavelength using quarter-wavelength (16 mm tall) resonators, formed from 1-mm-diameter metal rods, on a ground plane. The team investigated two different approaches: either displacing the position of one of the resonators in a pair, or detuning one resonator. A multiple-scattering-induced dipolar resonance was demonstrated, revealing a negative-effective-index region. The medium was shown to be able to support 'superlensing' of point sources of light; the approach may offer relatively low-loss subwavelength imaging as it is not, in principle, necessary to use metals. It is important to note that although the structure is periodic and resembles a photonic crystal, the array period is on a much smaller spatial scale. *DFPP*

https://doi.org/10.1038/s41566-019-0431-5

PHOTODETECTORS

Room-temperature nanowires

Nat. Nanotechnol. https://doi.org/c35b (2019)

Superconducting nanowire single-photon detectors offer impressive detection capabilities but applications are limited by their temperature of operation. Now, scientists from Canada and The Netherlands have shown that an array of tapered InP nanowires can offer high-efficiency, broadband and high-speed photodetection without the need for cryogenic cooling. The InP nanowire detectors operate over a 500-nm spectral bandwidth, spanning the ultraviolet to near-infrared, with an external quantum efficiency >85% and a gain of 10^5. Furthermore, they offer a timing jitter of <20 ps. The nanowires were fabricated by first growing planar layers of n- and p-doped InP using metal–organic vapour phase epitaxy. Next, nanoimprint lithography and reactive ion etching were used to produce cone-shape structures 1.6 μm high with a top diameter of 150 nm and a bottom diameter of 350 nm. Finally, electrode layers of indium tin oxide and Ti/Au were added to form a transparent top contact and a metal bottom contact. *OG*

https://doi.org/10.1038/s41566-019-0433-3

NANOWIRES

Telecom-band laser

Sci. Adv. **5**, eaat8896 (2019)

The development of miniature semiconductor lasers that cover the entire telecom-band wavelength range from 1.2 to 1.6 μm is desirable for optical fibre communication systems. Now, Guoqiang Zhang and co-workers from NTT Corporation, Japan have demonstrated optically pumped InP/InAs nanowire lasers that operate in this region with an exact wavelength that can be controlled by changing the thickness of the InAs quantum-well layer from 6.8 to 9.0 nm. The nanowire diameter and length were about 1 μm and 10 μm, respectively. High compressive strain was introduced in the InAs layers by the high lattice mismatch (3.1%) of the InP/InAs material system, in order to increase optical gain. The nanowires were excited by a picosecond laser emitting at 800 nm wavelength. The excitation-power-dependent photoluminescence measurements at room temperature revealed the lasing threshold at the excitation power to be in the range of 1.4 to 4.2 mJ cm^{-2}. Laser emission between 1.3 to 1.5 μm was observed. *NH*

https://doi.org/10.1038/s41566-019-0432-4

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