QUANTUM OPTICS
Efficient extraction
ACS Photon. http://doi.org/b8j6 (2017)

A bright and efficient integrated single-photon source has been made by combining a single InGaAs quantum dot with an optical element made by 3D printing technology. Scientists from Berlin and Stuttgart used electron-beam lithography to integrate the quantum dot with a GaAs microlens that sits on top of a distributed Bragg reflector. A multi-lens micro-objective was then fabricated by 3D femtosecond direct laser writing and precisely aligned to the microlens in order to efficiently extract the emitted photons. The resulting light source operates with a photon extraction efficiency of ~40%. The team says that excellent single-photon purity is obtained with a $g^{(2)}$ factor of <0.02, which indicates strongly suppressed multiphoton emission. The approach enables the excitation power for driving the emitter to be decreased by an order of magnitude. Future plans are to create a plug-and-play fibre-coupled single-photon source using the approach. *OG*

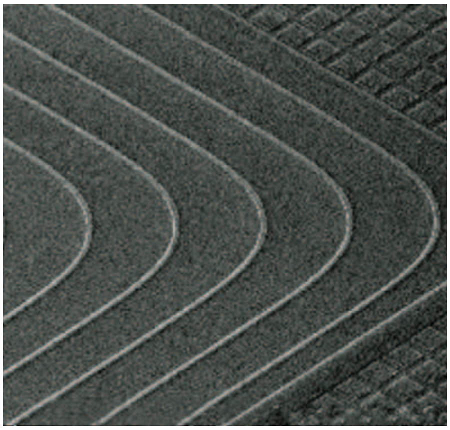
NANOPHOTONICS
Labelling worries
Sci. Adv. **3,** e1602991 (2017)

Fluorescent labels are commonly used to study molecular interactions, but it is not clear if or how their use affects molecular dynamics. Feng Liang and co-workers from the Rowland Institute at Harvard University in the US and Swansea University in the UK have now investigated this question in a quantitative manner using a plasmonic antenna-in-a-nanocavity single-molecule biosensor to study DNA–protein dynamics. The team discovered that widely used fluorescent reporters such as fluorescein isothiocyanate (FITC) and green fluorescent protein (GFP) decrease the interaction between DNA and a protein called XPA by a factor of 3 and 18, respectively, due to weakened electrostatic interactions. The study concludes that traditional fluorescent labelling methods might thus be causing molecular interactions to be misestimated in many circumstances. *OG*

SOLAR ENERGY
Fungi in the Sun
Adv. Mater. http://doi.org/f97kmx (2017)

The efficiency of solar-driven water evaporation devices, useful for applications such as desalination, can be enhanced using micro- or nanofabricated structures to improve broadband light absorption, optimize thermal management and create more water pathways. However, the added cost and complexity of utilizing such structures is not always acceptable. Now, Ning Xu and colleagues at Nanjing University have found that a readily available natural structure, the shiitake mushroom, can enable 78% conversion efficiency under 1 sun illumination. The mushroom's dark 'umbrella' aids light absorption while the porous portion underneath the umbrella as well as the fibrous stipe (stalk) help transport water. In their experiments, a supermarket-purchased shiitake was floated in a beaker of water housed in a solar simulator. Mass change was measured during illumination and the evaporation rate determined. The team found that the light absorption can be increased by carbonizing the mushroom; total absorption went from 79% to 96% and conversion efficiency increased from 62% to 78%. The mushrooms were carbonized by heating them for 12 hours at 500 °C in Ar gas. The pore and microfibre diameters approximately halved during carbonization, improving capillary action. *DP*

INTEGRATED OPTICS
Dense comb on a chip
Light Sci. Appl. **6,** e16260 (2017)



A dense frequency comb is usually generated using bulky and costly femtosecond lasers, whereas low-cost integrated semiconductor mode-locked lasers can typically only generate a comb with a small number of spectral lines with a larger spacing and broader optical linewidth. Now, combining the best of both worlds, Zhechao Wang and co-workers have demonstrated an ultra-dense comb laser based on a compact, low-cost, frequency-stabilized comb generator. They present a III–V-on-silicon mode-locked laser that is passively mode-locked and operates at a record low repetition rate of 1 GHz. The use of a low-loss (~0.7 dB cm^{-1}) passive silicon spiral waveguide allows a long laser cavity with a length of 37.4 mm. The cavity features two optical amplifiers that are separated by a saturable absorber, and two distributed Bragg reflectors that form the mirrors of the cavity. The device emits over a wide optical bandwidth of 12 nm, generating a dense optical comb consisting of over 1,400 equally spaced optical lines with narrow linewidth of <400 kHz. The team points out that several features provide evidence for stable mode-locking including a sub-kHz 10-dB radio-frequency linewidth and a narrow longitudinal mode linewidth. The researchers envisage that their integrated dense comb lasers will be useful for high-resolution real-time spectroscopy applications. *RW*

LASERS
Diode-pump fix
Opt. Express **25,** 12469–12477 (2017)

Although they are convenient and more compact, diode-pumped Ti:sapphire lasers tend to suffer from pump-induced loss. Now, Sterling Backus and co-workers from the USA have found a fix in the form of a single diode-pumped Kerr-lens mode-locked Ti:sapphire laser. A 465-nm diode laser with a lifetime of 10,000 hours and an output power of up to 4 W was used to pump a Ti:sapphire crystal. By using an aspheric lens and cylindrical telescope, the beam diameter of the diode laser was shaped to become 56 µm in the vertical direction and 118 µm in the horizontal direction. It is estimated that 70% of the pump light was absorbed in the 4.75-mm-long crystal. The Ti:sapphire laser mode-locked easily, producing 15.2 fs pulses, with no evidence of mode-locking instabilities. When the power of the diode laser was held constant at 3.1 W, the output power from the Ti:sapphire laser was 173 mW over 600 hours with a 0.33% root-mean-square stability. Contamination of the Ti:sapphire crystal, which is often evident on this timescale using traditional TEM_{00} green pump lasers, did not occur. The spatial mode quality of the output mode-locked beam was excellent with a beam quality factor M^2 of 1.02 in the horizontal direction and 1.17 in the vertical direction. *NH*

Written by Oliver Graydon, Noriaki Horiuchi, David Pile and Rachel Won.