Biofriendly nanowire lights up

Nature **447,** 1098–1102 (2007)

Scientists from the USA and Japan have now succeeded in making a nanowire-based source of coherent light that is biocompatible and suits *in situ* experiments. The optically pumped, electrode-free source is capable of generating continuously tunable light in the visible. Its developers, Yuri Nakayama and colleagues from Lawrence Berkeley National Laboratory, University of California, Berkeley, USA, and Sony, Japan, say that the device — an individual nanosized potassium niobate wire that is uniform in size, several micrometres long and about 50 nm in diameter — is a promising candidate for *in situ* scanning and fluorescence microscopy. Owing to the nonlinear optical properties of potassium niobate, a wide range of colours can be generated and tuned from the nanowire through sum and difference frequency generation. In their experiments, which involve second harmonic frequency generation, the scientists used infrared laser light with a wavelength of 1,064 nm as a pump source, which they also used as optical tweezers to manipulate and scan the nanowire over a sample. As well as scanning transmission mode, the scientists demonstrate experimentally that the single nanowire can also be used as a source of fluorescent excitation.

Ultrashort-pulse laser patterns living cells

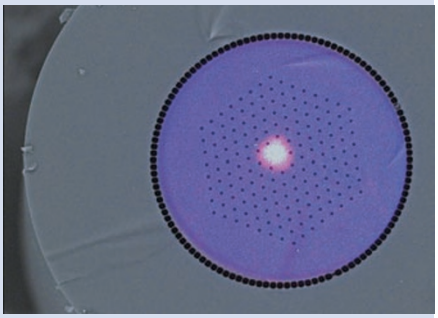
Appl. Phys. Lett. **91,** 023904 (2007)

Given the importance of cell arrays for biological applications, such as artificial-tissue design and studying cell–cell interactions, efficient patterning strategies that are not harmful to cells are needed. A group of researchers from Osaka University and Kyoto University in Japan now believes that it has the answer with a femtosecond laser-based approach, which minimizes dryness and photothermal and photochemical damage to cells. Unlike existing patterning approaches, the technique proposed by Takahiro Kaji and colleagues relies on the impulsive force induced by a high-intensity femtosecond laser in a small region of culture medium. In their approach, the laser does not directly irradiate the cells, making the technique suitable for patterning proteins and living cells, which are easily damaged. The researchers show experimentally that a femtosecond-laser-induced force can detach and transfer mouse fibroblast cells from a source substrate to a target substrate with about 80% of the cells kept alive three hours after patterning. They attribute the origin of the transfer force to bubble cavity and shockwave effects that are created by the femtosecond laser. The team is confident that this technique will help develop the field of regenerative medicine and tissue engineering.

Endoscope potential in three dimensions

J. Biomed. Opt. **12,** 040501 (2007)

High-resolution imaging is needed for early-stage disease diagnosis and monitoring. Nonlinear optical endoscopy has proved promising particularly for *in vivo* imaging at a cellular level. However, so far, its applications have been hindered by its low sensitivity and inflexible design. Now, Ling Fu and co-workers from Swinburne University of Technology, Australia, and the University of Florida, USA, have developed a miniature nonlinear endoscope that enables three-dimensional imaging *in vitro* with a penetration depth of about 100 μm and an axial resolution of 10 μm. The system comprises a highly reflective two-dimensional microelectromechanical-system (MEMS) mirror and a gradient-index lens, which are integrated with a photonic-crystal fibre. The researchers optimize the sensitivity of the system



SPIE

by using a double-clad photonic-crystal fibre with a large core and high numerical aperture to enhance nonlinear optical effects and signal collection. Although not yet observed, the team says that the approach is potentially promising for *in vivo* three-dimensional imaging of deep tissue, allowing tissue analysis without the need for extracting samples.

Multiple wavelengths enhance tomography

Opt. Lett. **32,** 2285–2287 (2007)

Performing ultrasound-modulated optical tomography with two wavelengths rather than just one could offer a convenient method of monitoring the total haemoglobin concentration and its level of oxygen saturation (SO_2) in biological tissue, according to scientists in the USA. In preliminary tests, Chulhong Kim and Lihong Wang from Washington University shone two beams of red light (633 nm and 657 nm) and a series of short 1-MPa ultrasonic pulses into a tissue phantom made of gelatin and cornstarch. The phantom was 20 mm thick and contained seven embedded targets, each $2.2 \times 2.2 \times 11$ mm^3 in size and featuring a different concentration of red and blue dyes to mimic oxygenated and deoxygenated haemoglobin. Speckle patterns emerging from the phantom were captured by a CCD camera with and without the ultrasonic transducer activated, and signal-contrast analysis was then able to determine the total dye concentration and the ratio of dyes in each of the targets. From the positive results the team holds the opinion that the approach could be extended to provide functional, non-invasive imaging of the total haemoglobin concentration and SO_2 levels in tissue *in vivo*.

Microrings sense proteins

Opt. Express **15,** 7610–7615 (2007)

Miniature silicon-on-insulator microring resonators that occupy an area of less than 10×10 μm^2 could be an attractive option for sensitive, label-free biosensing of proteins when combined with microfluidics, according to researchers in Belgium. Katrien de Vos and colleagues from Ghent University have now shown that such high-quality-factor, low-loss resonators are able to sense protein concentrations down to 10 ng ml^{-1} by measuring small refractive-index changes and thus wavelength shifts in the resonant light, which result from the presence of protein in the surroundings of the microring. To optimize its sensitivity to protein, the silicon surface of the microring was treated with a protein-binding layer. The researchers say that the ability to manufacture such microrings by standard CMOS electronics processing techniques (such as deep-UV lithography) potentially offers cheap mass production and ease of integration with electronics to create 'lab-on-a-chip' systems. In particular, when integrated with a microfluidic circuit thousands of devices could be lined up in arrays for multiparameter sensing within a few square millimetres.