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Manufacturing of Integrated Photonic Devices

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In recent decades the adoption of lasers for material processing has enabled new manufacturing techniques for inscription, welding, cutting and 3D fabrication. Ultrafast Laser Inscription is a unique method of material modification where an ultrashort laser pulse is focused into a material transparent to the laser wavelength. The laser pulse is absorbed at the focus through nonlinear processes creating a highly localised modification allowing for 3D fabrication within a sample. Depending on the sample and the laser parameters various modifications are possible such as refractive index change, damage and the formation of nanocracks. Refractive index change, both positive and negative is used to form waveguides as illustrated in *Figure 1*.

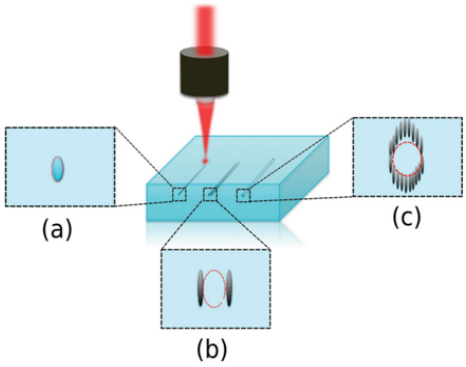

Figure 1: Ultrafast laser machining of waveguides: (a) type 1, (b) type 2 and (c) depressed cladding. The red line in each image indicates the guiding region [1].

By exploiting the nanocracks in silica glasses we have recently fabricated of microfluidics for biological applications, this can be combined with the integration of optical waveguides to produce highly compact integrated devices. This is illustrated in figure 2.

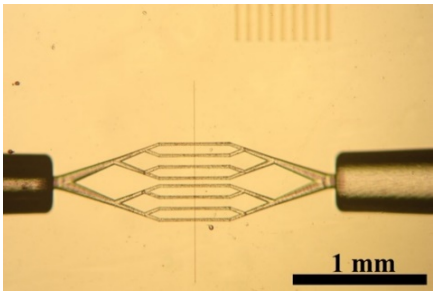

Figure 2: Microfluidic device for cell imaging [5].

Talk will concentrate on how leading companies are exploiting this technology to manufacture unique photonic devices.

References:

[1] "Ultrafast laser inscription: perspectives on future integrated applications", *Laser & Photonics Reviews* **8**, 6, 827, 2014.

[2] "Imaging Flow Cytometry With Femtosecond Laser-Micromachined Glass Microfluidic Channels", *IEEE Journal of Selected Topics in Quantum Electronics* **21**, 6800106, 2015.