New Configurations and Novel Fabrication of Optical Microresonators

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Optical passive and active microresonators are versatile optical devices and show the potential to become compact building blocks in larger integrated systems performing key optical signal processing functions such as wavelength filtering, switching, regeneration, and buffering. Some of these functions find already widespread use in novel optical sensor arrangements and can be potentially employed in future advanced telecom systems. Various microresonator geometries have been studied each with associated unique characteristics. We have recently fabricated two novel optical microresonators namely the "microdiscus" and the "microbottle", and studied their performance (1,2). This abstract briefly describes the fabrication and preliminary characterization of the microresonators and the detailed results and analysis will be presented at the conference.

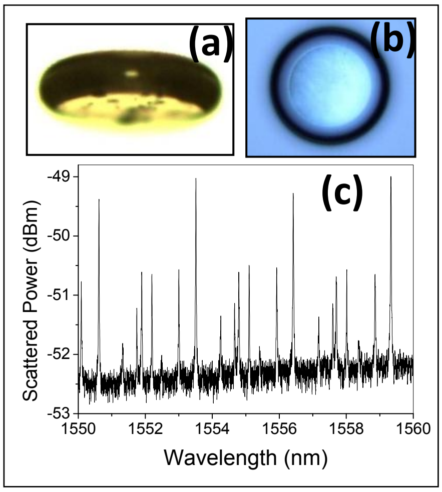

Fig. 1: (a) side and (b) top view of the fabricated microdiscus with (c) its resonance spectrum.

The microdiscus resonators were fabricated by a novel "soften-and-squash" process from functional glass microspheres by heat treatment and pressure. This process is simple and versatile and produced microdiscus with (i) high Q due to enhanced surface quality, (ii) easy alignment due to the flat shape and (iii) fewer, more clearly defined resonances due to the strong asphericality. Fig. 1 (a) and (b) show side and top views of a fabricated microdiscus. Resonance characterisation of the microdiscus (Fig. 1c) showed promising results with Q-factors exceeding 10^5 (1), which is about two orders of magnitude higher than the original commercial microspheres used for the fabrication.

Another novel resonating microstructure we have fabricated is a robust whispering-gallery-mode microbottle resonator (Fig. 2a) by a very simple and versatile "soften-and-compress" technique, employing a standard fibre fusion splicer and normal telecommunications fibre with loaded Q factors of about 10^7 (Fig.2 (b) and (c)) (2). The "bottle" shape is an important parameter in defining the spectral characteristics and optical properties of the resonator. The shape is defined by the softening temperature profile and the applied compression and can easily be controlled to produce the required bottle shape.

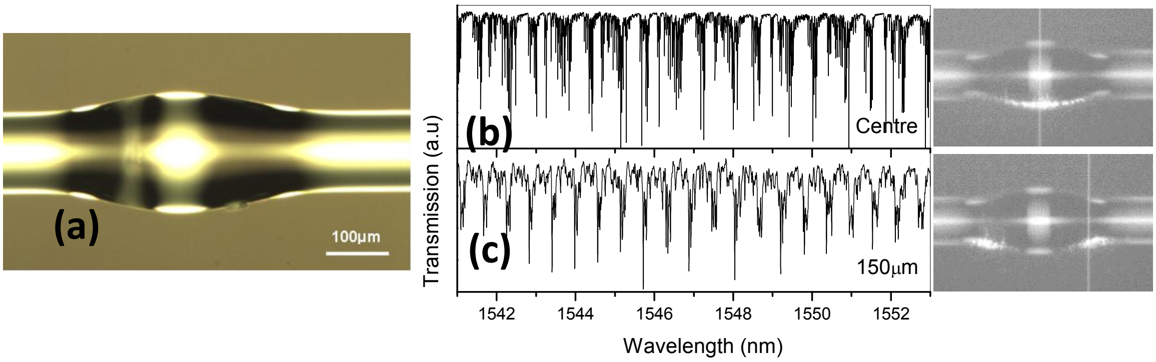

Fig. 2: (a) Optical micrograph of a bottle microresonator and resonance spectra when excited (b) at the centre and (c) 150μm away from the centre, respectively along with micrographs showing the tapered fibre excitation.

References

1) G. Senthil Murugan, J. S. Wilkinson and M. N. Zervas, Appl. Phys. Lett. (2012) Submitted.
2) G. Senthil Murugan, James S Wilkinson and Michalis N Zervas, Opt. Express **17**, 11916 (2009).