Fabry-Perot vapour microsensor onto fiber endface fabricated by multiphoton polymerization technique

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We report on a Fabry-Perot optical resonator fabricated on the endface of a SMF28 fiber, by employing the direct laser writing technique [1]. We explore this fiber sensing probe for measuring the vapour of common organic solvents [2]. The material used for the fabrication of the microstructure is a zirconium-silicon, photosensitive organic-inorganic hybrid material [3]. The sensing head consists of a “prism” like structure suspended on four pillars, attached onto the silica fiber endface (Fig. 1a). This architecture allows the formation of a small air cavity, between the fiber endface and the microstructure, which acts as a Fabry-Perot resonator, providing interrogation capabilities of the intermediate optical medium. To avoid a multiple Fabry-Perot resonation between the two surfaces of the fabricated microstructure, which can complicate the interrogation spectrum, an inclination of about 20^o was given across the outer surface of the microstructure. Liquid or gaseous media can penetrate in the empty space of this microcavity, detecting refractive index or absorption changes occurring in reflection mode. The 20μm air cavity demonstrated here results a periodic modulation of the reflected optical spectrum by notches of ~20dB in amplitude strength and a free spectral range of ~88nm.

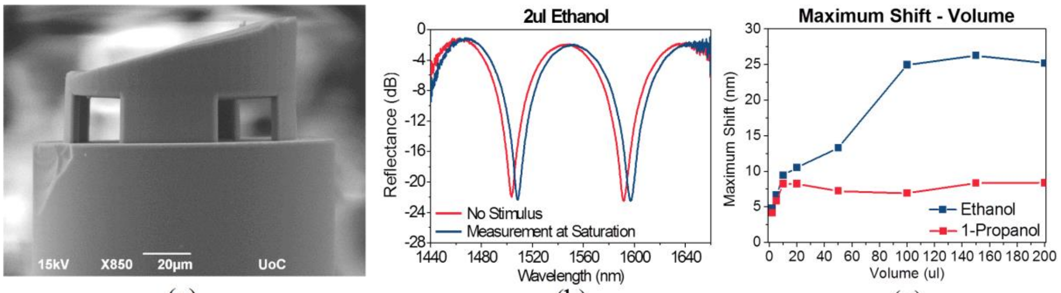

Figure 1: (a) SEM image of the microstructure on the endface of the fiber, (b) Reflection spectrums of 2ul Ethanol, (c) Shifts of the Fabry-Perot for two different alcohols for a variety of volumes.

We have tested the operation of this sensing probe for vapours of two different alcohols, those of 1-propanol and ethanol, at several different gaseous concentrations spanning from 11mbar to 65mbar. The behavior of the sensing probe presented herein has been also explained using standard physisorption mechanisms. Further work is carried out for fully characterizing and optimizing this novel sensing probe; there have been already demonstrated chemo-sensing and magnetosensing functionalities using this micro-optical configuration.

References

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2. M. Konstantaki et al., *Opt. Exp.* **20**, 8472 2012).
3. I. Sakellari et al, *ACS Nano* **6**, 2302 (2012).

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