

Measurements of the chromatic dispersion of wine models using a fibre long period grating

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Invited contribution

We present an optical fibre device for real-time measurements of near infrared spectrum of chromatic dispersion of a liquid medium. It is based upon two collocated fibre long period gratings ('Bi-LPG') written adjacent to each other in the core of the optical fibre by femtosecond laser direct inscription. The Bi-LPG arrangement produces a series of attenuation bands, each one being associated with one cladding mode, and thus creating a refractive index measuring channel [1]. The demonstrated device is designed to produce eight independent such measuring channels, distributed across the 1268-to-1642 nm spectral range. This device was tested on a series of buffer solutions containing chemical compounds over a range of concentrations that would be found in commercial drinks such as wine, like malvidin, acetaldehyde or tartaric acid [2]. The results showed that the optical fibre device yields distinctive spectral response and hence distinct chromatic signatures for each compound. The measured limits of detection (LOD) for all ten studied compounds range from 1×10^{-3} to 6×10^{-5} mol/L, depending on the compound refractivity. For most of them, the found LOD are below the usual concentrations present in commercial drinks like wine. Furthermore, we observed these distinctive spectral responses varied as a function of the compound's concentration. This shows that the optical fibre multi-channel analyser would be capable of monitoring in real time a substance's effective chromatic dispersion for real-world applications. For example, such monitoring of the beverage fabrication process would complement used traditional techniques such as off-line optical spectroscopy. This is not offered by any current technology in any field of application. This concept would be applicable to any other liquid medium, whether homogeneous, heterogeneous, clear or turbid, such as biologic liquids

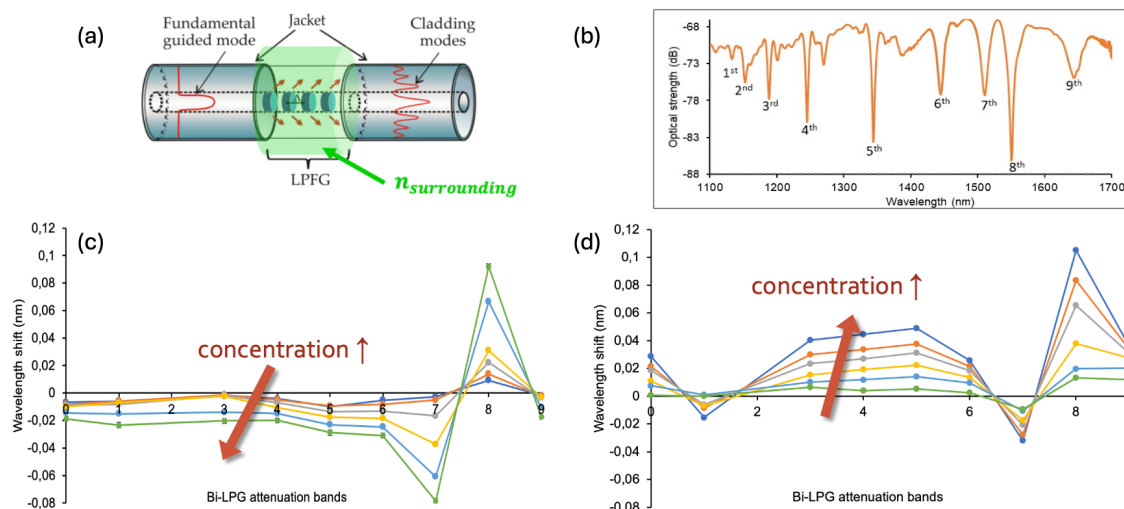


Fig. 1 (a) Schematic of a LPG fiber sensor, coupling the core- to cladding-modes. (b) transmission spectrum of the Bi-LPG sensors with periods of 339 μm and 525 μm , 50 % duty cycle in air at 23.5 $^{\circ}\text{C}$. (c-d) Wavelength shift of the attenuation bands vs molar concentrations of chemicals for (c) malvidin ($3 \cdot 10^{-8}$ to $3 \cdot 10^{-2}$ mol/L) and (d) methional ($9.6 \cdot 10^{-8}$ to $9.6 \cdot 10^{-2}$ mol/L). Error bars are (± 1.3 pm), size of the markers.

References

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