CONTINUOUS WAVE STIMULATED RAMAN SPECTROSCOPY INSIDE A HOLLOW CORE PHOTONIC CRYSTAL FIBER

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Hollow-core photonic crystal fibers[a] (HCPCF) have raised new opportunities to study light-matter interaction. Dielectric or metallic capillaries are intrinsically lossy, making poor light guides. In contrast, HCPCFs can guide light quite efficiently, due to the band-gap effect produced by an array of smaller channels which surrounds a central hollow core with a few μm diameter. The tight confinement of light inside the core, that can be filled with gases, as well as a long interaction length, enhance multiple nonlinear phenomena, making it possible to devise new ways to do low signal level spectroscopy, as is the case of high resolution stimulated Raman spectroscopy (SRS). A. Owyoung[b] demonstrated high resolution continuous wave SRS in 1978. Shortly afterwards, seeking higher sensitivity, he developed the *quasi-continuous* SRS technique (a high peak power pump laser, interacting with a low power cw probe laser). That variant remains today the best compromise between resolution and sensitivity for gas-phase Raman spectroscopy.

In this work, we show the possibility of fully cw stimulated Raman spectroscopy, using a gas cell built around a HCPCF to overcome the limitations posed by the weakness of the stimulated Raman effect when not using pulsed sources. The interaction length (1.2 m), longer than that of a multiple pass refocusing cell, and the narrow diameter of the core (4.8 μm), can compensate for the much lower laser powers used in the cw set-up. The experimental complexity is considerably reduced and the instrumental resolution is at the 10's of MHz level, limited, with our fiber, by transit time effects. At present, we have demonstrated the feasibility of the experiment, a sensitivity enhancement of $\sim$ 6000 over the single focus regime, and a spectral resolution better than 0.005 cm^{-1}in the unresolved Q-branch of the ν_1 component of the Fermi dyad of CO_2 at 1388 cm^{-1}. Other examples of rotationally resolved spectra will be shown: the Q branch of O_2 at 1555 cm^{-1}, and the $2\nu_2$ component of the Fermi dyad of CO_2 at 1285 cm^{-1}.

[a] P. St. Russell, *Science* **299**, 358, 2003.

[b] A.Owyoung, C. W. Patterson, R S. McDowell, *Chem. Phys. Lett.* **59**, 156, 1978