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RAMAN THERMOMETRY OF CONFINED GAS MICRO-FLOWS

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Microfluidics devices with internal gas flows are nowadays subject of a rapid development. These devices often operate in rarefied gas flow regimes, since the ratio of the molecular mean free path over the channel dimensions becomes non-negligible. In those rarefied flows, effects like temperature-jumps near the wall are expected to occur. However, there is a lack of experimental techniques capable of measuring the internal properties, such as temperature, in gas flows confined in small channels [1].

Raman spectroscopy is a powerful non-intrusive technique to probe gas jets at the molecular level with high spatial resolution, as we have demonstrated in the Laboratory of Molecular Fluid Dynamics of the IEM [2].

Here we present a first proof-of-concept application of Raman thermometry to the gas flows within the millimetre channels. For this work, we have designed several channels with forced thermal gradients, and demonstrated that the gas temperature in the flow can be retrieved, with high spatial resolution, from the rotational and vibrational Raman spectra of molecules like N2, CO2 and acetone.

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[1] S. Colin, J.M. Fernández, C. Barrot, L. Baldas, S. Bajic, M. Rojas-Cárdenas. "Review of Optical Thermometry Techniques for Flows at the Microscale towards Their Applicability to Gas Microflows". Micromachines 13, 1819 (2022)
[2] https://www.iem.csic.es/fismol/fdm/publications.html

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