MID-IR ETHENE DETECTION USING A QUASI-PHASE MATCHED $LiNbO_3$ WAVEGUIDE

ROBERTO GRILLI, *School of Chemistry, University of Bristol, Bristol BS8 1TS, U.K.*; LUCA CIAFFONI, GRANT A. D. RITCHIE, *Department of Chemistry, Physical and Theoretical Chemistry Laboratory, University of Oxford, South Parks Road, Oxford OX1 3QZ, U.K.*; and ANDREW J. ORR-EWING, *School of Chemistry, University of Bristol, Bristol BS8 1TS, U.K.*.

A periodically poled $LiNbO_3$ waveguide has been used to produce up to 200 μW of mid-infrared light around 3081 cm^{-1} with a wide tunability range of $>$33 cm^{-1}. Two commercial near-infrared diode lasers at 1.064 μm (pump) and 1.583 μm (signal) are mixed in a nonlinear optical crystal to achieve difference frequency generation. The 48 mm long direct-bonded quasi-phase matched periodically poled $LiNbO_3$ waveguide shows a conversion efficiency of 12.3 %/W. The radiation sits in an important window of the mid-infrared spectral region, where a large number of fundamental vibrations of several hydrocarbons occur. Applications in trace gas detection have been demonstrated for ethene, using multi-pass absorption coupled with wavelength modulation spectroscopy to reach a minimum absorption coefficient of 3×10^{-7} cm^{-1} $Hz^{-1/2}$. The relatively high power of the mid-infrared idler radiation obtained shows great potential for higher sensitive techniques such as cavity enhanced absorption spectroscopy and cavity ring-down spectroscopy, and preliminary results will be presented.[a]

[a] L. Ciaffoni, R. Grilli, G. Hancock, A.J. Orr-Ewing, R. Peverall and G. A. D. Ritchie *Appl. Phys. B* **94**, 517-525, 2009.