PROGRESS TOWARDS MID-INFRARED FIBRE LASERS IN RARE-EARTH DOPED GALLIUM LANTHANUM SULPHIDE GLASS FOR GAS SENSING AND REMOTE SENSING

T. Schweizer, D.J. Brady, B.N. Samson, D.W. Hewak, and D.N. Payne
Optoelectronics Research Centre, University of Southampton, Southampton, SO17 1BJ, United Kingdom, Tel.:+44-1703-593172, Fax:+44-1703-593149, E-mail:ts@orc.soton.ac.uk

Diode-pumped rare-earth doped fibre lasers in the mid-infrared wavelengths region would offer a compact and efficient alternative to the either relatively weak or very complex existing mid-infrared sources such as thermal emitters, gas lasers and OPOs. A prerequisite for the rare-earth host material is a low phonon energy leading to mid-infrared transparency and to low nonradiative decay rates and therefore higher quantum efficiencies of mid-infrared transitions. Conventional silica glass fibres cannot fulfill these requirements leading to a need for new glass materials with lower phonon energies which must also be suitable for fibre pulling.

Our approach towards mid-infrared laser sources is based on the stable, non-toxic and non-hygroscopic chalcogenide glass gallium lanthanum sulphide (GLS) with the molar composition $70Ga_2S_3{:}30La_2S_3$ which has been pulled into fibre form successfully [1]. It has a low phonon energy (425 cm^{-1}) and a wide infrared transmission extending beyond 8 μm. The characterization of undoped GLS glasses and fibres such as loss measurements and theoretical loss calculations will be presented in another paper at this conference [2].

In this paper we present the spectroscopy of rare-earth doped GLS glasses and fibres which show fluorescence at wavelengths which are interesting for gas sensing and remote sensing. Examples are the 3.4μm emission from praseodymium and the 4.3μm emission from dysprosium which overlap with the strong fundamental absorption bands of methane and carbondioxide, respectively, and could therfore find application as gas sensors for these two important greenhouse gases. The emission of thulium at 3.8μm and holmium at 3.9μm fall into the atmospheric window with the highest transmission and could therefore be suitable for remote sensing applications.

Laser action an the above transitions has not been achieved to date but the first laser action in a rare-earth doped chalcogenide glass fibre which has been demonstrated in a neodymium doped GLS fibre shows the potential for mid-infrared fibre lasers in this chalcogenide glass system [3].

[1] D.W. Hewak, R.C. Moore, T. Schweizer, J. Wang, B. Samson, W.S. Brocklesby, D.N. Payne and E.J. Tarbox, Electron. Lett. **32** (1996) 384-385

[2] D. Brady, T. Schweizer, J. Wang, and D.W. Hewak, submitted to QE-13

[3] T.Schweizer, B.N. Samson, R.C. Moore, D.W.Hewak, and D.N. Payne, Electron. Lett. **33** (1997) 414-416