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THULIUM-DOPED LEAD GERMANATE FIBRE LASERS

D.J.B.Brinck, C.J.Mackechnie, J.Wang, J.R.Lincoln, W.S.Brocklesby, A.C.Tropper, D.C.Hanna and D.N.Payne
Optoelectronics Research Centre and Department of Physics, University of Southampton, Southampton, SO9 5NH.

To date research on optical fibre lasers and amplifiers has mainly concentrated on two classes of host glass, silicates and fluorozirconates. In this paper we present results obtained from a new glass, based on lead germanate. This glass has been chosen to answer a need for a host having a maximum phonon energy intermediate between that of silica and fluorozirconate glass. The specific glass composition was also developed to be suitable for fibre fabrication. We report results of lasing on two transitions in thulium-doped lead germanate fibre. Recently this new glass has also been shown to be compatible with ion implantation techniques to produce planar waveguide lasers.

One of the disadvantages of silica as a glass fibre laser host is that its high maximum phonon energy leads to rapid non-radiative decay between levels of dopant ions, so that these ions have relatively few metastable levels, thus limiting the number of possible laser transitions. Fluorozirconates, such as ZBLAN, with a much lower phonon energy, allow many more metastable levels. On the other hand, since non-radiative decay processes can in some circumstances be of value in channelling excitation to the upper laser level, the need can arise for a specific, optimum value of phonon energy. The 1.9μm transition in Tm^{3+}, pumped at 790nm, is such a case in point where a phonon energy intermediate between that of silica and ZBLAN is called for and it was to optimise the performance of this laser that we developed this new glass. It should also be added that ZBLAN is difficult to fabricate, fragile and hygroscopic. The new lead germanate fibre shows good mechanical properties and can be fabricated by the standard rod-in-tube method.

We will present results for lasing performance in a thulium-doped lead germanate fibre. The observed threshold for the 1.9μm transition, 3.6mW using a diode pump, is the lowest reported for this transition, indicating that the deliberate choice of host phonon energy can be beneficial. This transition is of interest for LIDAR, sensors and medical applications so the lead germanate system, with further optimisation, could play an important role in these areas. Another wavelength of interest is at 810nm which falls within the first telecommunications window. We report lasing at this wavelength in a Tm-doped lead germanate fibre resonantly pumped at 790nm. The possibility of high gain on this transition has been confirmed with the observation of lasing directly off the uncoated cleaved ends of the fibre.

1. J.R.Lincoln, C.J.Mackechnie, J.Wang, W.S.Brocklesby, R.S.Deol, A.Pearson, D.C.Hanna and D.N.Payne; Electron Lett. 28.11, pp1021-22 (1992)

2. J.Wang, J.R.Lincoln, W.S.Brocklesby, R.S.Deol, C.J.Mackechnie, A.Pearson, A.C.Tropper, D.C.Hanna, D.N.Payne; to be published in J. Appl. Phys.