

1388

SPIE 1996
Denver, Colorado
paper 2841-29

1 DOPED FIBER DEVICES

M.F.Digonnet and F.Ouellette

2 Photon avalanche upconversion in heavily thulium-doped ZBLAN fibre

3 Bernard Jacquier, Stephan Guy, Marie-France Joubert

LPCML-Universite Lyon1-URA 442 du CNRS

43 Boulevard du 11 novembre 1918 69622 Villeurbanne France

Tel: (33) 72 44 83 36, fax: (33) 72 43 11 30

Dave P. Shepherd

Optoelectronics Research Center, University of Southampton

Highfield, Southampton UK

Hubert Poignant

CNET-LANNION, LAB/RIO/TSO,

22301 Lannion France

4 Oral presentation

5 Photon avalanche mechanism results from a cross relaxation energy transfer induced build up of population in an intermediate metastable level without resonant Ground State Absorption (GSA). From this level a resonant absorption occurs to populate a higher level. The main characteristics of such process is a power threshold which corresponds to a sudden increase of the fluorescence arising from the upper excited state as well as a slowing and a change of the rise shape of the transient signals.

In the case of thulium, one excited thulium ion in the 1G_4 level may provide three ions in the 3F_4 metastable state. We report the first observation of avalanche upconversion pumped blue fluorescence in a 3.2 Wt% thulium-doped ZBLAN fibre which was grown at CNET. The red pump absorption, blue (450nm, 480nm) fluorescence risetimes and output intensity (as well as side luminescence) were measured as the pump power was increased. Characteristic avalanche behaviour was observed such as low threshold and high order pump dependence. Spectroscopic measurements have allowed to distinguish between GSA, ESA and photon avalanche mechanisms by assignment of the different excitation bands. It is shown that, at high power, the dominant fluorescence arises from the 1D_2 level to 3F_4 at 450nm which is strongly reabsorbed under photon avalanche pumping conditions. Optimization of the optogeometrical parameters of the fibre as well as concentration dependence are considered for a suitable blue upconversion laser system.

6 Thulium, fluorescence, rare earth-doped fluoride fibre, photon avalanche, upconversion lasers.

7 Bernard Jacquier is Directeur de Recherche at CNRS, manager of the group Rare earth doped Waveguides at LPCML since 1987.

Stephan Guy is from Ecole Normale Supérieure de Lyon, he got his Phd last december 1995 from University of Lyon on photon avalanche.

Marie France Joubert is Charge de Recherche at CNRS since 1982, working in the field of upconversion mechanisms at Université of Lyon

Dave P Shepherd is Senior Research Fellow at the Optoelectronics Research Center since 1994, He was invited two months at the University of Lyon in 1995.

Hubert Poignant is with CNET Lannion working in the area of fibre devices for telecommunication applications