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High-Power Er^{3+}/Yb^{3+} fibre laser pumped by a 962nm diode-array.

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Abstract.

A high power (96mW) Er^{3+}/Yb^{3+} fibre laser pumped with a 962nm diode array is reported. The device operated at 1.536μm, had a threshold of 130mW and a slope efficiency with respect to launched power of 17%.

Summary.

The sensitisation of Er^{3+} doped fibres with Yb^{3+} is well established as a technique for increasing the choice of pump wavelengths for the Erbium system [1,2]. This has led to the development of high-power fibre lasers and amplifiers pumped indirectly by laser-diode arrays operating in the 800nm band. These fibre lasers used a tandem pumping scheme in which the diode array pumps an intermediate laser, eg a miniature Nd^{3+}:YAG laser [2], or a double-clad Nd^{3+} fibre laser [3], which in turn pumps the Er^{3+}/Yb^{3+} fibre at around 1.06μm.

Double clad fibres allow laser diode arrays to be efficiently coupled to a single mode doped core [4]. In the double clad arrangement pump light is launched into a multimode cladding and subsequently absorbed in the core. The absorption length is thus increased in proportion to the inner cladding/core area ratio. Direct pumping of Er^{3+} doped fibre with 800nm diodes arrays is not realistic since the increase in absorption length in the double clad geometry causes a prohibitive increase in the threshold pump power. The recent development of diode arrays in the range 950nm-980nm radically changes this situation. The high absorbtion cross-section of Yb^{3+} allows such pump power to be efficiently absorbed in a double clad structure.

The double clad Er^{3+}/Yb^{3+} fibre was fabricated by coating a silica based Er^{3+}/Yb^{3+} single mode fibre with a low index silicone coating. The pump source was an SDL 6462 1W array, centred at 962nm. Pump light was launched through a 960/1530nm dichroic mirror into the inner cladding of the Er^{3+}/Yb^{3+} fibre, with an efficiency of 70%. A cleaved fibre end was used as the output coupler.

Figure 1 shows the lasing characteristic with respect to launched pump power, indicating a threshold of 130 mW, a slope efficiency of 17% and a maximum output power of 96mW. The length of fibre used was 1.8m and the throughput pump power 80 mW (at maximum power). The lasing spectrum is shown in figure 2. The lasing wavelength of 1536.3 nm is a clear indication of genuine three level operation. Figure 3 shows the effect of pump wavelength on lasing threshold. This data was obtained with a Ti^{3+}

sapphire pump source, and shows that a broad range of pump wavelengths can be used.

In conclusion we have demonstrated efficient operation of an Er^{3+}/Yb^{3+} fibre laser that directly uses a laser diode array as pump source. We expect that improvements in fibre design will allow an output power in excess of 200mW. The device is scalable with pump power and with suitable re-configuration could be employed as a high power amplifier.

References.

1 Townsend.J.E, Barnes.W.L, Jedrzejewski.K.P and Grubb.S.G, Elect Lett, **27**, 1958 (1991).

2 Grubb.S.G, Windhorn.T.H, Humer.W.F, Sweeny.K.L, Leilabady.P.A, Townsend.J.E, Jedrzejewski.K.P and Barnes.W.L, OSA meeting "Optical amplifiers and their applications" Snowmass USA, PdP12 1-4 (1991).

3 Minelly.J.D, Laming.R.I, Townsend.J.E, Barnes.W.L, Taylor.E.R, Jedrzejewski.K.P and Payne.D.N. OFC 92, TuG2 p32 (1992).

4 Po.H, Snitzer.E, Tumminelli.R, Zenteno.L, Hakimi.F, Cho.N.M and Haw.T, OFC 89, PD7 (1987).

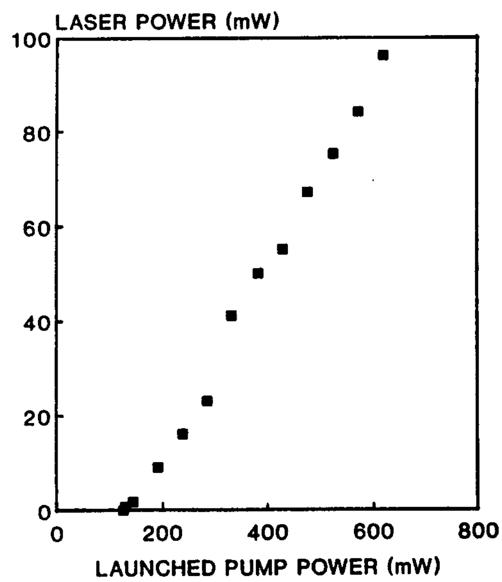

Fig 1, LASING CHARACTERISTIC

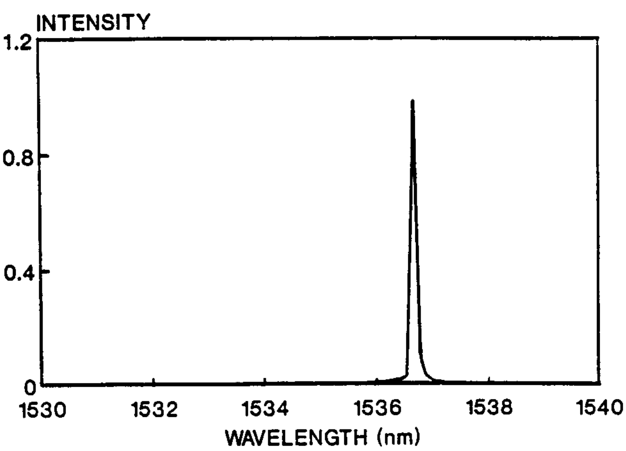

Fig 2, FIBRE LASER OUTPUT SPECTRUM

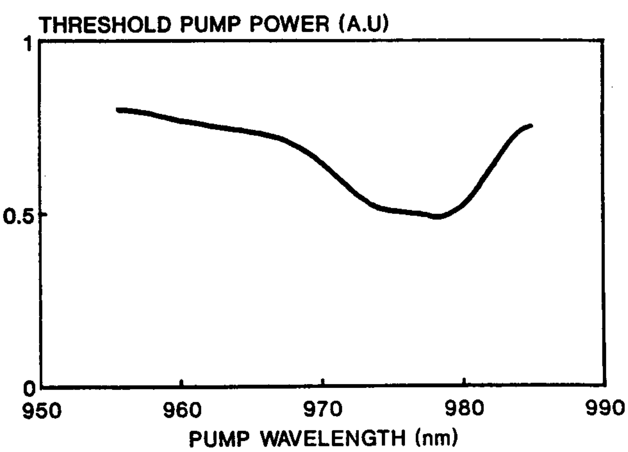

Fig 3, THRESHOLD vs PUMP WAVELENGTH