A diode-pumped, first window optical fibre amplifier providing up to +12 dBm of output

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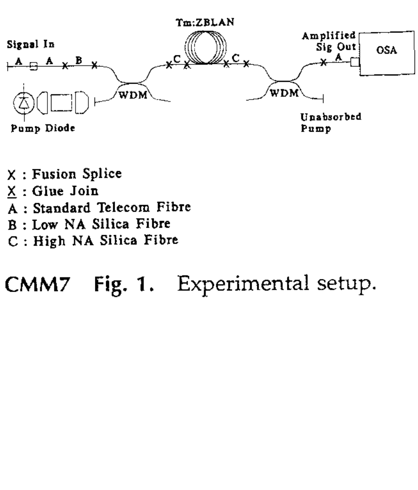
The thulium ion is one of great interest when it is doped within fluorozirconate glass due to the number of transitions available for stimulated emission. One such transition is the $^3F_4$ to $^3H_6$ transition at 0.8 μm. This is of interest as it lies within the first window for optical communication. There is growing interest in the use of this window for local area networks, passive optical networks, or supervisory systems. Small signal amplification of up to 23 dB has been reported for this transition in a thulium-doped fluoride fibre using a Ti:sapphire laser as the pump source.[1] We report here the first diodepumped operation of this optical amplifier. An intrinsic small signall gain in excess of 30 dB was achieved. With a launched 807-nm signal power of −10 dBm, intrinsic gain of 21 dB was observed, producing amplified output powers of +11 dBm. An intrinsic gain of greater than 20 dB was observed for signals over the spectral range of 802 nm to 810 nm. The greatest amplified output power obtained for this system was 12.8 dBm for 30 mW of launched diode pump power.

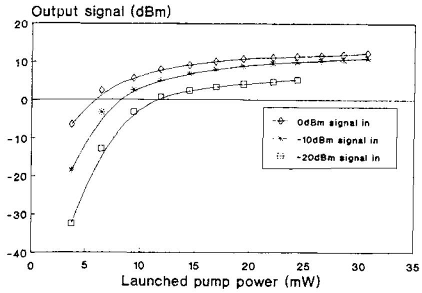
The experimental configuration used is shown in Fig. 1. The entire system was fibre-connectorised using fusion splices for silica-silica joins and glue splices for fluoride silica joins. The system started and ended with standard 1.3 μm telecommunications fibre. WDM couplers, optimised for 780 nm and 815 nm operation, were used at both ends to combine and split the pump and signal light. Undoped silica fibre was used to optimise coupling from the large-core telecommunications fibre down to the small-core fluoride fibre, and back again to the output. This enabled us to glue-join a silica fibre to the fluoride fibre with losses of only 0.4 dB by butt-joining two flat cleaved ends together and gluing.

Figure 2 shows the amplified signal power at the end of the fluoride fibre as a function of the pump power launched into the fluoride fibre. The three curves correspond to launched signal power values of 0 dBm, −10 dBm, and −20dBm. For a signal power as low as −20 dBm, saturation effects are still evident. This is shown in Fig. 3, which shows the variation of amplified signal power with respect to signal power launched into the fluoride fibre for launched pump powers of 7.5 mW, 15 mW and 30 mW.

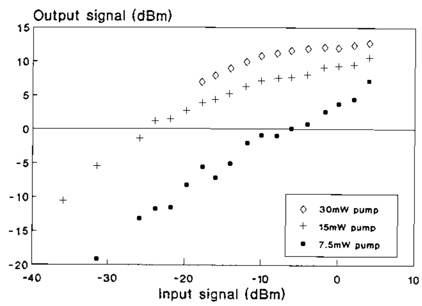
As can be seen from Figs. 2 and 3, efficient amplification can be achieved with a modest amount of diode pump power launched into the fluoride fibre. The system gain from telecoms fibre to telecoms fibre for a signal power of −10 dBm was 14 dB. This performance could be improved by removal of the output WDM coupler, and refinement of the system.



CMM7 **Fig. 1.** Experimental setup.



CMM7 **Fig. 2.** Amplified signal output at end of fluoride fibre as a function of launched pump power for three signal powers.



CMM7 **Fig. 3.** Amplified signal output at end of fluoride fibre as a function of signal power launched into the fluoride fibre for three launched pump powers.

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1. R. G. Smart, A. C. Tropper, D. C. Hanna, J. N. Carter, S. T. Davey, S. F. Carter, D. Szebesta, "High efficiency, low threshold amplification and lasing at 0.8 μm in monomode Tm^{3+}-doped fluorozirconate fibre," Electron. Letts. **28**(1), 58–59 (1992).