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Single Mode Neodymium Fibre Lasers

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A laser medium in the form of a single mode optical fibre offers a number of attractive features. For example, using a laser to end pump such a fibre provided with feedback mirrors, allows a very low oscillation threshold to be attained. In the case of Nd doped fibre a GaAs diode laser can be used as the pump, thus providing a very simple and compact laser device. The low threshold performance also suggests that other, weaker transitions may be capable of laser action eg. the 1.3μm $^4F_{3/2} \rightarrow {}^4I_{13/2}$ transition in Nd or transitions in other dopants which have not previously shown laser action in a glass host. Other possible applications include the use of fibres as amplifiers e.g. as an in-line amplifier in an optical communication system where it could play the role of a repeater. As a power amplifier the fibre device could have advantages over the bulk glass systems by reducing the problems of thermal distortion and thermal fracture. In this paper we report some results obtained with neodymium-doped single mode fibres.

The fibres have been fabricated by a modified chemical vapour deposition technique in which the materials of the fibre core, including the dopant, are introduced as volatile compounds. The fibres tested so far have been of fused silica, with core diameter of 4 microns and Nd ion concentrations around 300 ppm. Initial tests involved end-pumping a fibre with a C.W. Rhodamine 6G dye laser, tuned to Nd-pump transitions around 595nm, where the absorption was measured to be ~30dB/m. Losses at the lasing wavelength (1.088μm) have

been measured to be less than 10dB/km. Resonators have been constructed either with mirrors separate from the fibre ends with microscope objectives to couple in and out of the fibre, or with mirrors butted against the fibre ends. With the former arrangement a lasing threshold corresponding to a few milliwatts of absorbed dye laser power was obtained.