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QE12 submission
Sept. 1995

ADVANCES IN CLADDING PUMPED FIBRE LASERS.

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Cladding pumping is a technique whereby high power broadstripe diodes and diode bars are employed as efficient pump sources for double-clad rare earth doped single-mode fibres [1],[2]. Output powers ranging from several hundred milliwatts to several tens of watts have been attained with this technique. Important application areas include telecommunications, medicine, laser marking and laser radar.

When the double-clad fibre technology is combined with a recent beamshaping technique, [3] for circularising without brightness reduction the line output from high power diode laser sources the scope for laser development is greatly enhanced.

The optimal geometry of the double-clad fibre is dependent on the power regime required for a given application and whether the lasing transition is three or four-level. We have developed two different techniques for the fabrication of all-glass double-clad silica based fibres suitable for different pumping conditions. An all-glass cladding provides superior power handling than the normal silicone-clad fibres and also facilitates endface termination.

The first technique, which is ideal for diode bar pumping, involves sleeving a standard rare-earth doped single-mode fibre preform with a plasma deposited fluoro-silicate layer. This process can give a numerical aperture up to 0.25. We have achieved inner cladding diameters in the range 80-400μm.

For pumping three-level fibre lasers with broadstripe diodes in the 1-4 Watt regime a smaller inner cladding waveguide of between 20μm and 50μm diameter is more suitable. The reduced area ratio of the inner cladding to core minimises the threshold penalty associated with the double-clad pumping scheme in three-level systems. For such cases we have developed an alternative fabrication process in which what is effectively a double step-index fibre with doped inner-core is fabricated in a single process at the solution doping stage.

We have investigated fibres doped with Nd^{3+}, Yb^{3+}, Er^{3+} co-doped with Yb^{3+} and singly-doped Er^{3+}. We will report on the performance of fibres fabricated by each of the above techniques in various power regimes.

References

1. H.Po et al, Proc. OFC, Houston, PD7, (1989).
2. H.Po et al, Electron Lett, **29**, pp. 1500-1501, (1993).
3. W.A.Clarkson et al, Proc. CLEO (Europe), CFH6, Amsterdam, (1994).