High power resonantly pumped holmium-doped fibre sources

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Laser sources operating in the spectral region beyond 2 µm are of interest for a range of applications in the areas of remote sensing, medicine, industrial materials processing and defence. These applications require a diverse range of sources of various temporal, spectral and output power levels to meet their requirements.

The operation of silica fiber lasers at 2 µm has advantages in terms of the suppression of non-linear effects such as stimulated Brillouin and Raman scattering which can limit high power operation of fibre based devices. The majority of silica fibre based sources developed for the 2 µm spectral region have used thulium fibres. Various pulsed sources have been realised, including Q-switched, gain switched and mode-locked lasers. CW thulium sources have been demonstrated at more than 1 kW of output power with excellent beam quality, as well as narrow line-width operation producing 608 W of output power. Further power scaling of thulium lasers is currently limited by diode brightness and the thermal performance of coating materials.

Resonantly pumped holmium fibre lasers have several advantages over thulium based devices. Of particular interest is the ability to operate in the atmospheric transmission window beyond 2.1 µm. For high power operation the resonantly pumped holmium fibre architecture has advantages for power scaling due to the availability of mature thulium fibre lasers operating at 1.95 µm. These lasers can be utilised as high brightness pump sources providing thermal advantages and flexibility in fibre design. We have demonstrated a kW power level array of monolithic thulium fibre lasers, and used it to resonantly pump a holmium fibre laser to achieve 400 W in CW operation at 2.12 µm. Further power scaling of holmium fibre lasers and amplifiers applicable to both pulsed and CW operation is currently being performed.

We will review the benefits of resonantly pumped holmium fibre lasers, and present recent results of the high power operation of both CW and pulsed sources. These results demonstrate the utility of this fibre laser architecture and its suitability for high power laser operation and for providing pump sources for non-linear frequency conversion.

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High power sources based on cladding-pumped holmium fibres have advantages in relation to atmospheric transmission in the spectral region beyond 2.1 μm and for high power operation in comparison to thulium based devices. We have demonstrated pulsed and CW sources utilising resonantly pumped holmium fibres, with output powers of more than 400 W achieved in CW operation

We will review the advantages of devices based on resonantly pumped holmium fibres and present recent results for the high power operation of CW and pulsed devices. These results demonstrate the utility of this fibre laser architecture and its suitability for remote sensing, medical, industrial and defence applications.