OMICS International
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Chia-lung Tsai et al., J Laser Opt Photonics 2016, 3:1(Suppl)
http://dx.doi.org/10.4172/2469-410X.C1.003

International Conference on
Quantum Physics and Nuclear Engineering
March 14-16, 2016 London, UK

Homogeneous broadening linewidth reduction at room temperature at short-wavelength gain boundary of erbium-doped fiber lasers

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It is an important phenomenon that homogeneous broadening effect makes the rare-earth-ion doped fiber amplifiers to have a broad and continuous gain bandwidth. The homogeneous broadening effect is widely observed at room temperature in isotropic glass materials and is highly dependent on the energy manifolds. The laser transition between two higher energy sublevels is usually corresponding to a shorter homogeneous broadening linewidth. This also implies that laser power variation coming from the impact of an adjacent wavelength is more alleviated at the shorter wavelength in gain bandwidth. The typical homogeneous broadening linewidth of a silica-based erbium-doped fiber laser is about 3-4 nm, 4-6 nm, and 6-8 nm, for the S-band (1450-1520 nm), C-band (1530-1560 nm), and L-band (1565-1610 nm) wavelengths, respectively. On the other hand, homogeneous broadening effect is also influential to the laser linewidth. However, it is not clear because the laser is normally happening at the gain peak wavelength without using a filter at a specific passband wavelength. In this work, we found that it is very interesting to investigate the homogeneous broadening effect at the short-wavelength edge of the gain boundary in erbium-doped fiber laser. In contrast to the conventional continuous wavelength tuning erbium fiber laser at C-band or L-band, the laser characteristics show very different behaviours to make the lasing wavelength splitting into multiple fine lines only at the extreme edge of the short-wavelength gain boundary and which has not yet been proposed. To achieve the lasing at the extreme short-wavelength gain boundary, an in-line fiber short-pass filter is incorporated into the erbium fiber laser ring cavity and the fundamental mode cutoff wavelength is thermally tuned to efficiently enforce the lasing moving toward the shortest end of the gain boundary to successfully reduce the homogeneous broadening effect to achieve multiple fine laser lines.

Biography

Chia-lung Tsai is currently pursuing Master's in Optical Engineering from National United University, Taiwan.

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