Comparison of Multimode GRIN-Fiber Raman Lasers with FBG and Random DFB Cavity

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Raman fiber lasers (RFLs) have such advantages as flexible operating wavelength, low quantum defect, absence of unfavorable effects of amplified spontaneous emission and photo-darkening [1]. In addition, RFL may operate without a conventional cavity, *via* Rayleigh backscattering forming random distributed feedback (DFB) along with a single-mode passive fiber, see [2] and citation therein. Another direction which attracts lots of attention deals with the great potential in achieving brightness enhancement (BE): high-brightness signal laser at low-brightness pumping, in particular, in commercially available multimode GRIN fibers [3,4].

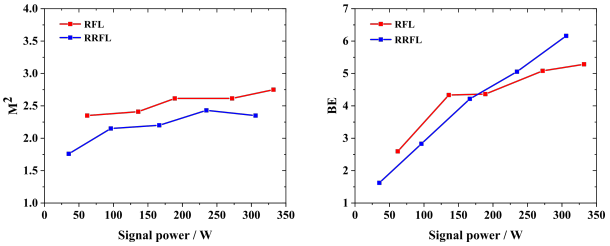

Figure 1: Comparison of RFL and RRFL output beam parameters: M^2 (a) and BE (b)

Here we compare two-cavity configurations of Raman laser based on multimode GRIN-fiber of 62.5/125 um core/cladding diameters pumped by ~700 W multimode source with beam quality M^2~10 based on combined Yb-doped fiber lasers. The first configuration consists of highly-reflective (R~90%) fiber Bragg grating (HR FBG) inscribed in GRIN fiber by conventional UV technology and output coupler (OC) FBG, inscribed in the central part of GRIN fiber core by point-by-point femtosecond laser technology so that fundamental mode has reflection R~4% whereas higher-order modes have 10 dB lower reflection. It is similar to a conventional RFL cavity consisting of two FBGs [1], but here OC FBG has, in addition, transverse mode selection properties. The second configuration is based on the half open-cavity with the same UV-inscribed HR FBG and random DBF via Rayleigh backscattering along with the GRIN fiber instead of OC FBG. So it corresponds to random RFL (RRFL) [2], but in multimode fiber, with a potential of transverse mode selection via Rayleigh backscattering.

Results of the comparison for output beam quality M^2 and corresponding brightness enhancement (BE) factor are shown in Figure. 1. Though RRFL configuration has a sufficiently higher threshold, it has higher slope efficiency and as a result comparable output power (>300 W) at maximum pumping. At that, it has better beam quality (M^2~2.3) and higher value of BE~6 in comparison with RFL (see Fig. 1). Comparison of other output parameters such as line width and shapes, beam shapes and OSNR values with the corresponding analysis of the observed differences will be presented at the conference.

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