A Brillouin fiber laser at 2 µm based on a step-index tellurite (TeO_2) optical fiber

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Abstract: We experimentally demonstrate a single frequency Brillouin fiber laser at 2-µm using a passive fiber ring cavity. A low lasing threshold of 70 mW was achieved with a 2m length of step-index Tellurite-glass optical fiber.

Stimulated Brillouin scattering (SBS) in optical fibers is a nonlinear process with important applications such as distributed optical fiber sensing, microwave photonics, optical storage, and fiber lasers [1–3]. The latter application has attracted significant interest as highly coherent laser sources with sub-Hz linewidth can be achieved using SBS in optical cavities. To date, most of Brillouin fibers lasers (BFLs) have been designed at 1.55 µm. However, for high resolution molecular sensing and coherent lidar, there is a need to develop laser sources at longer wavelength range [4,5].

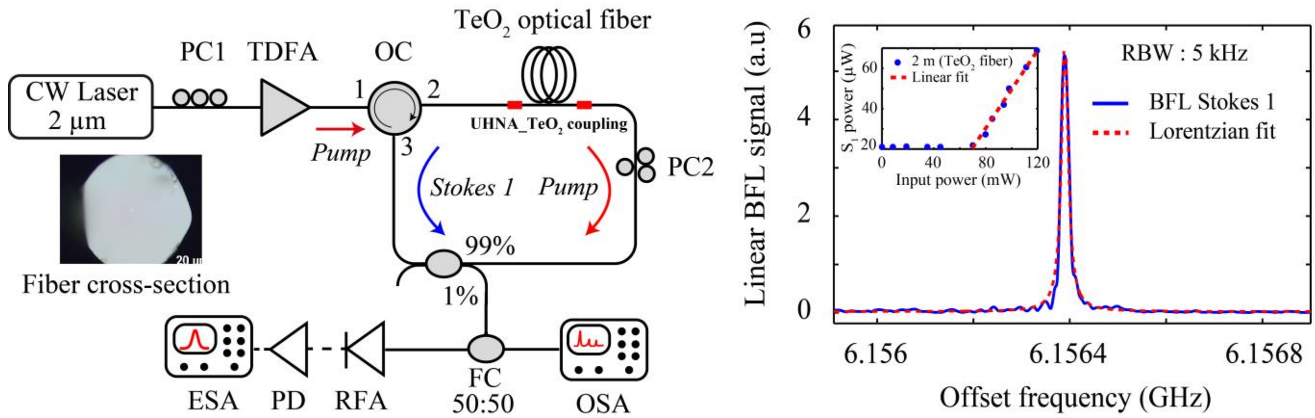

Fig. 1. (a): Left, Experimental setup for Brillouin fiber laser. CW: Continuous wave, TDFA: Thulium doped fiber amplifier, OC: Optical circulator, PC: Polarization controller, ESA: Electrical spectrum analyzer, RFA: Radiofrequency amplifier, FC: Fiber coupler, OSA: Optical spectrum analyzer. (b): Right, Output laser RF spectrum and Stokes Brillouin power diagram.

In this work, we demonstrate Brillouin lasing around 2-µm using a step-index tellurite-glass optical fiber as the Brillouin gain medium. The experimental setup and fiber cross-section are shown in Fig. 1(a), while Fig.1 (b) shows the Stokes power as a function of pump power. We measured at 2-µm pump wavelength a lasing threshold of only 70 mW and a high Brillouin gain estimated to be 10.5 $m^{-1} W^{-1}$. The Brillouin frequency shift was 6.156 GHz. Finally, the beat signal linewidth between the Brillouin Stokes and the pump light was measured to be 48 kHz. We are working on linear losses on the cavity to increase the lasing efficiency.

References

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