

# A Brillouin fiber laser at 2 $\mu\text{m}$ based on a step-index tellurite ( $\text{TeO}_2$ ) optical fiber

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**Abstract:** We demonstrate Brillouin lasing at 2- $\mu\text{m}$  using a step-index Tellurite-glass optical fiber in a passive fiber ring cavity. A low lasing threshold of 70 mW was achieved with a Brillouin gain of  $1.05 \times 10^{-10}$  m/W for a Brillouin frequency shift of 6.165 GHz.

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 [1]. To date, most of Brillouin fibers lasers (BFLs) have been designed at 1.55  $\mu\text{m}$ . However, for many applications in the mid-infrared region, there is a need to develop laser sources at longer wavelength range.

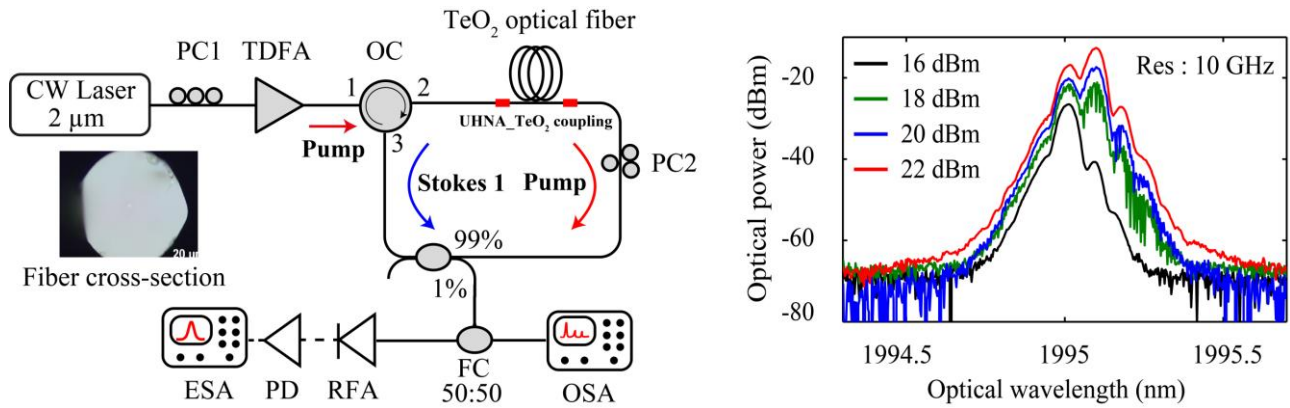


Fig. 1: Left, Experimental setup for Brillouin fiber laser. CW: Continuous wave, TDFA: Thulium doped fiber amplifier, OC: Optical circulator, PC: Polarization controller, ESA: Electrical spectrum analyzer, RFA: Radiofrequency amplifier, FC: Fiber coupler, OSA: Optical spectrum analyzer. Right, Output laser spectra at 2  $\mu\text{m}$  for an increasing pump power.

In this work, we demonstrate Brillouin lasing around 2- $\mu\text{m}$  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 output laser spectra for an increasing pump power. We measured at 2- $\mu\text{m}$  wavelength a lasing threshold of only 70 mW and a high Brillouin gain coefficient estimated to be  $1.05 \times 10^{-10}$  m/W. The Brillouin frequency shift was 6.165 GHz. Finally, the beat signal linewidth between the Brillouin Stokes and the pump light was measured to be 48 kHz.

## References

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