Short cavity Brillouin Random Laser

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***Abstract*— We report on random lasing realized with 100-m-long Rayleigh fiber fabricated with multiple reflection centers inscribed in the fiber core and uniformly distributed over the fiber length. Extended fluctuation-free fragments in the oscilloscope traces highlight power behavior typical for lasing.**

Keywords—fiber laser; random lasing; Rayleigh fiber;

SUMMARY

We report on random lasing[1-5] realized with Brillouin scattering in a new fiber material, an artifice Rayleigh fiber. In contrast to previous experiments[4] we employed 100-m fiber length only to demonstrate the lasing effects.

The germanium-silicate fiber was fabricated on IRE drawing facility. Multiple weak reflectors are inscribed in the fiber core by an excimer laser operating at 248 nm through a phase mask, in-situ, immediately during fiber drawing process. The peak reflectivity of a single reflector is estimated to be as low as ~0.0001%. All reflectors are uniformly distributed over the fiber length with a step of ~1.1 cm. The total reflectivity exhibits a peak at 1552 nm and is ~1.5%. (Fig.1(a, b)).

The experimental configuration of the laser is shown in Fig. 1 (c). A 100 m long optical fiber is pumped through an optical circulator from 350mW narrow-band laser source that is 100 kHz 20-mW tunable Agilent continuous wave laser operating at near 1550 nm coupled with an erbium doped amplifier (EDFA). Pumping the fiber provides Brillouin amplification over the fiber length within the spectral band Stokes–side shifted by the Brillouin frequency shift $\Delta_{SBS} \sim 11GHz$ from the pump frequency ν_L. At the far end, the fiber is supplied by the fiber Bragg grating (FBG) with 70pm reflectivity band centered at 1552 nm. The laser operates employing the distributed reflectors inscribed in the fiber. Fig.1 (d) shows the laser spectra recorded at the output 1. The Brillouin threshold is achieved with 150 mW pump power. However, the most efficient power conversion to the Stokes wave (output 2) is observed from the pump power levels of 200 mW highlighting the lasing threshold. The recorded power behavior demonstrate a clear competition between SBS and Brillouin lasing. Fig.1 (e) shows an extended fluctuation-free fragment with power behavior typical for laser radiation. Different techniques tested for the laser stabilization will be discussed during the talk.

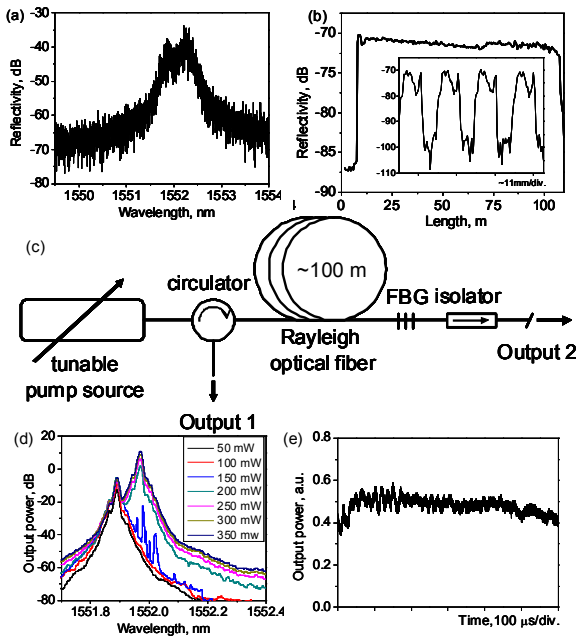

Fig.1. Reflectivity spectrum (a) and OFDR (Luna 4600) traces (b) of the Rayleigh fiber, experimental laser configuration (c), spectra (d) and oscilloscope trace (e) recorded with the laser.

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