Covalent Organic Framework with Polarization Dependence for Ultrafast Pulse generation

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Covalent-organic frameworks (COFs) are novel materials known for their ordered, crystalline, low-density, and porous structure, making them useful for various applications [1,2]. In this work, a specific polarization-dependent COF named π-electron-extended porphyrin/pyrene-linked COF (PorPh-PyTA-COF) was used as a saturable absorber (SA) for mode-locking operation in the 1.5 μm spectral region. The mode-locked fiber laser was successfully demonstrated by leveraging this polarization dependence and saturable absorption of the COF.

The PorPh-PyTA-COF was first synthesized using a solvothermal method, and the PorPh-PyTA-COF powder was accordingly embedded in a polyvinyl alcohol (PVA) film (COF-PVA SA) [3]. The saturation intensity and modulation depth were therefore characterized with values of 0.5 kW/cm^2 and 0.8%. In addition, the polarization-dependent loss (PDL) of 3.7 dB was observed. The schematic of the Er-doped mode-locked fiber laser is summarized in Fig 1 and the mode-locking operation is achieved by adjusting the polarization state and pump power.

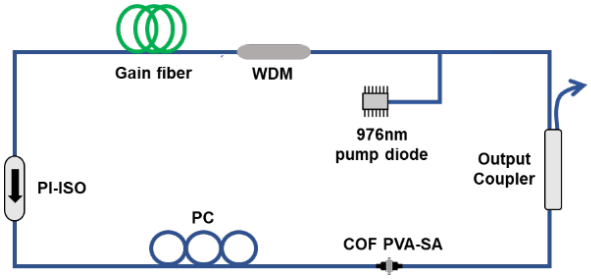

Fig. 1 Experimental setup of the mode-locked Er-doped fiber laser using a COF-PVA SA.

Figure 2 shows the laser performance while pumping with 361mW. The output power is around 0.32mW. The central wavelength of 1570 nm and full width at half maximum (FWHM) of about 5.2 nm were analyzed; see Fig 2(a). Figure 2(b) shows the autocorrelation trace of the laser output, and the corresponding pulse duration is 506 fs. The repetition rate of 20MHz can be obtained from the pulse train, as shown in the inset of Fig 2(b). In addition, the time-bandwidth product (TBP) can be accordingly calculated to be 0.32, close to the Fourier transform limit of a sech^2 pulse. This is the first time COFs could be used to generate mode-locking pulses.

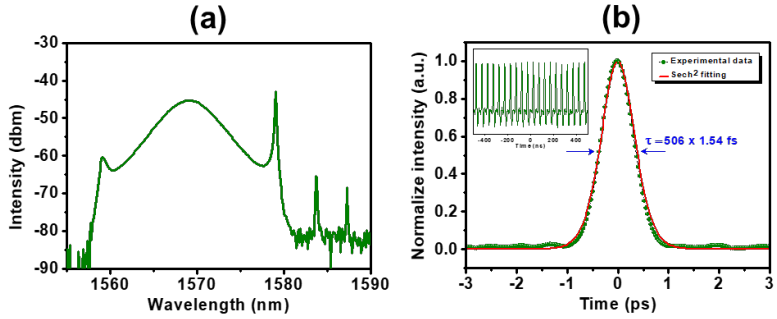

Fig. 2 The mode-locked EDFL has based on COF-PVA SA (a) optical spectrum (b) autocorrelation trace: insert pulse trains.

In summary, this study explored the feasibility of using COFs as a SA for mode-locked fiber lasers in the 1.5 μm wavelength region. The experimental results suggest that COFs have significant potential in ultrafast photonics and open new possibilities for future SA technologies.

References

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