phase. Thus, the output pulse energy of DSs can realize a remarkable increase. The formation of DSs is generally understood as a balance result of saturable absorption, group velocity dispersion, self-phase modulation, gain and loss, as well as spectral filtering. Moreover, the 45° TFG and two PCs functioning as an artificial saturable absorption promotes the formation of DSs.

The polarization state of the DS is investigated by employing a bulk PBS and a PC external to the cavity, as shown in Fig. 2. The bulk PBS with 40 dB PER is used to resolve the two orthogonally polarized components. The PC3 controls the linear birefringence of fiber. The power meter monitors the power from one output port of the PBS. Adjusting the PC3, the PER of output pulses is calculated as ~26 dB by measuring the maximum and minimum output power, which indicates the pulse is nearly totally polarized. The PER of output pulse is lightly less than the PDL of 45° TFG due to the output coupler with non-polarization maintaining fiber pigtail. The single-polarization output pulse is desired for different applications such as optical parametrical devices, interferometric fiber sensors, pumping of active crystals, and non-linear frequency conversion. Compared with commercial fiber or bulk polarizers, the 45° TFG possesses the born preponderance: high PDL, high damage threshold, and wide operating bandwidth. Therefore, the 45° TFG and two PCs function as an artificial saturable absorption, which offers an attractive opportunity to implement stable, compact, high-power, single-polarization and all-fiber ultrashort-pulse laser sources. Furthermore, all-fiber polarization interference filter based on the 45° TFG can also help to achieve multiple-wavelength laser [33].

5. Conclusions

We have experimentally demonstrated dissipative solitons delivered from an all-normal dispersion Yb-fiber laser based on the 45° TFG. Mode-locked DS with the duration of 4 ps and bandwidth of 9 nm is obtained. The corresponding time-bandwidth product of ~10 indicates that the output pulse is chirped, while the parabolic phase profile denotes the chirp is nearly linear across the pulse. The measured PER of output pulse is ~26 dB, which denotes that the pulse operates in the single-polarization state. Experimental results reveal that the 45° TFG together with two PCs can work as an equivalent saturable absorber and help to the realization of self-started mode locking. As a result, the 45° TFG can pave a new way for the realization of stable, compact, high-power, single-polarization and all-fiber ultrashort-pulse laser sources.

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