全偏光保持繊維化リオフィルターの熱ドリフト特性と波長可変レーザーへの応用

Thermal Drift Characteristics of All-Polarization-Maintaining Fiberized Lyot Filter and Its Application for Tunable Laser

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Here we report the study of thermal drift of a home-made all-polarization-maintaining (PM) fiberized Lyot filter. The filter is used to develop a tunable all-PM fiber laser. The robustness of long-term operation of the proposed laser is also demonstrated.

The schematic diagram of the proposed laser is illustrated in Fig. 1(a), which consists of a WDM/Tap hybrid for injecting pump light and extracting output signal, 1.4-m PM erbium-dopped fiber as gain medium, an isolator to ensure unidirectional propagation and a PMF taper based Lyot filter for wavelength tuning. The PMF taper is heated by an electrical heat pad with a resolution of 0.1℃. The thermal drift is shown as Fig. 1(b), where the central wavelength shifts for ~6.1 nm from 21 to 35℃. The laser would reach its boundary of the effective mode-locked bandwidth when the temperature is adjusted over 35.5℃. Since the room temperature is 21℃ that the heat pad cannot be lowered below, we only measured the spectrum of 17.3℃ by placing the fiber on the surface of a box filled with ice water to cool it. Figure 1(c) presents the results of wavelength tuning based on thermal drift, which shows a good linear relationship around 0.45 nm/℃. Moreover, the long-term stability is measure as shown in Fig. 2. The performance without thermal control is depicted in Fig. 2(a) and 2(b), in which the bound pulses are switched between 4 different states in 70 mins. After imposing thermal control, the bound pulses can maintain good consistency. Figure 2(c) visualizes the variations of power density and wavelength of central wavelength components. Robustness has been greatly improved.

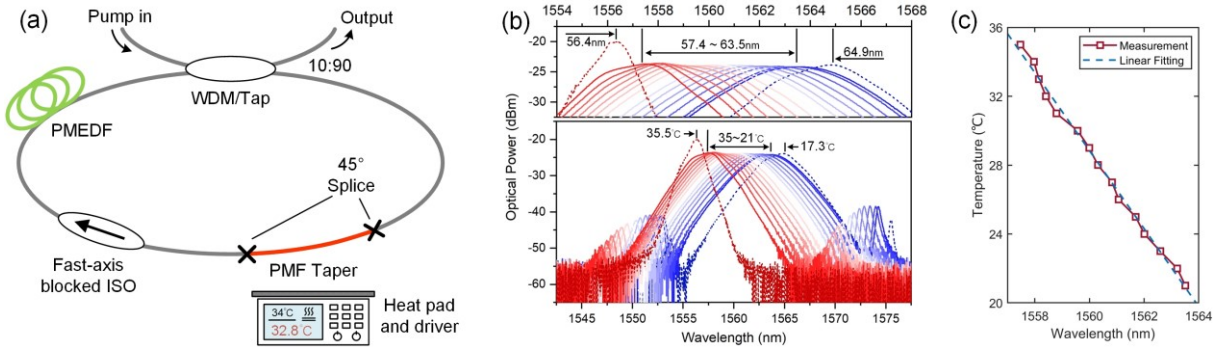

Fig. 1 (a) The schematic diagram of the tunable laser; (b) Spectra and (c) linear relationship of temperature-controlled wavelength tuning.

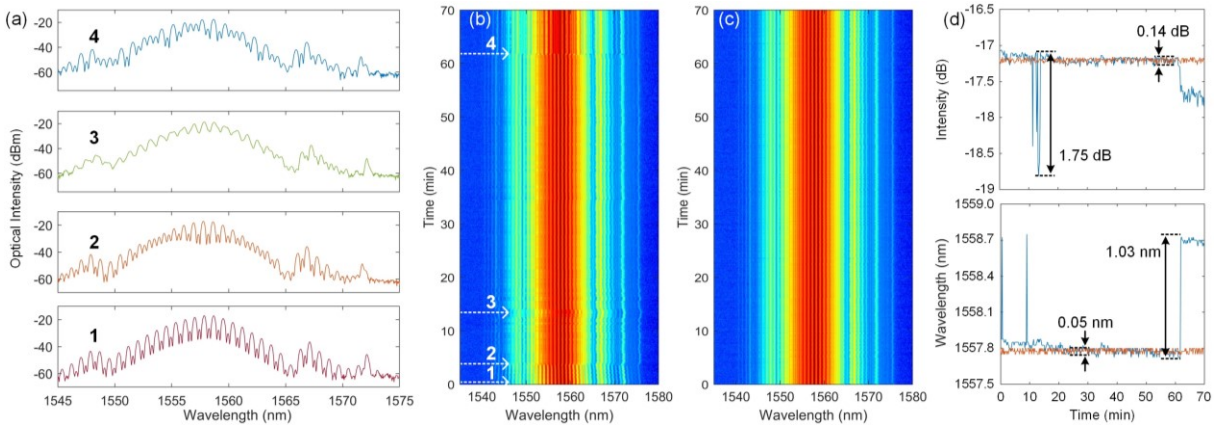

Fig. 2 (a) Four transition states in (b) long-term continuous operation without temperature feedback; (c) Results with temperature feedback; (d) Variation of the central wavelength and its power density.