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摘要：研制了一款超低噪声单频可调谐高抗振激光器，介绍了它的工作原理和设计方案。该激光器工作波长为1 550 nm，主要由单频激光谐振腔、保偏光纤放大器以及监控反馈光路组成。采用了精密稳定的闭环温控技术，使得激光器的工作温度极其稳定，温度控制分辨率达0.001℃。使用了鉴频部件及配套闭环系统锁定激光器的输出频率和功率，由此不仅保证了波长和功率的稳定性能，而且大大降低了激光器的低频噪声，同时制备的激光器光学膜也有效地提高了激光损伤阈值。与同类激光器的性能相比，设计的光纤激光器可保证功率稳定性优于1%，相对强度噪声优于-130 dBc/Hz；选择不同类型的种子光源谐振腔，激光器的线宽可控制在1~400 kHz。另外，激光器的最大波长调谐范围为3 nm，输出功率可达1 W。在频率为1 Hz时，其相位噪声低于 $10 \mu\text{rad} \cdot \text{Hz}^{-1/2}/\text{m OPD}$ ；抗振动能力可达到 $0.1g$ （ g 为重力加速度）。

关键词：保偏光纤激光器 可调谐激光器 低噪声 抗震 单频

Ultralow-noise tunable single-frequency fiber lasers

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Abstract: A tunable single frequency laser with ultralow-noise and high vibration resistance is developed, and its working principle and structure design are introduced. The laser worked at 1 550 nm is consisted of a single frequency laser resonant cavity, a polarization containing optical fiber amplifier and a monitoring feedback optical path. By using a closed-loop temperature control technology, the laser shows a higher precision and stability, and its extremely temperature control resolution is up to 0.001℃. Using frequency components and a matched closed-loop system, the locked output frequency and power of the laser are implemented. The closed loop system not only gives the stability of wavelength and power, but also greatly reduces the low frequency noise of the laser system and effectively improves the laser damage threshold. As a result, the fiber laser can provide the long-term power stability better than 1% and the relative intensity noise better than -130 dBc/Hz. By selecting different types of seed light source cavities, the laser line-width can be controlled in the 1-400 kHz. Furthermore, the output power of fiber laser is 1 W and tunable wavelength is 3 nm. At 1 Hz, the phase noise is less than $10 \mu\text{rad} \cdot \text{Hz}^{-1/2}/\text{m OPD}$ and the shock resistance ability is $0.1g$ (g for the acceleration of gravity).

Keywords: polarization maintaining fiber laser tunable fiber laser ultralow noise high vibration resistance single frequency

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