

Multi-wavelength thulium-doped fiber laser by using Sagnac loop mirror

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1. INTRODUCTION

Multi-wavelength lasers operating at 2 μm wavelength band by using Thulium-doped fiber (TDF) have become a hot research topic in recent years due to their many advantages including wide lasing spectral range, eye safety wavelength and high brightness. Multi-wavelength laser output can be achieved by using intra-cavity comb filters. Various optical fiber comb filters were studied to achieve multi-wavelength laser output at 2 μm . However, the number of lasing wavelengths in these reported Thulium-doped fiber lasers (TDFLs) is usually limited and the side-mode suppression ratio (SMSR) is not high enough.

2. EXPERIMENTAL SETUP

A 1.5 m-long double-cladding TDF with core diameter of 10 μm and cladding diameter of 130 μm was used as the gain medium. The TDF was pumped by using a 793 nm laser diode through a 793/2000 nm wavelength-division multiplexer.

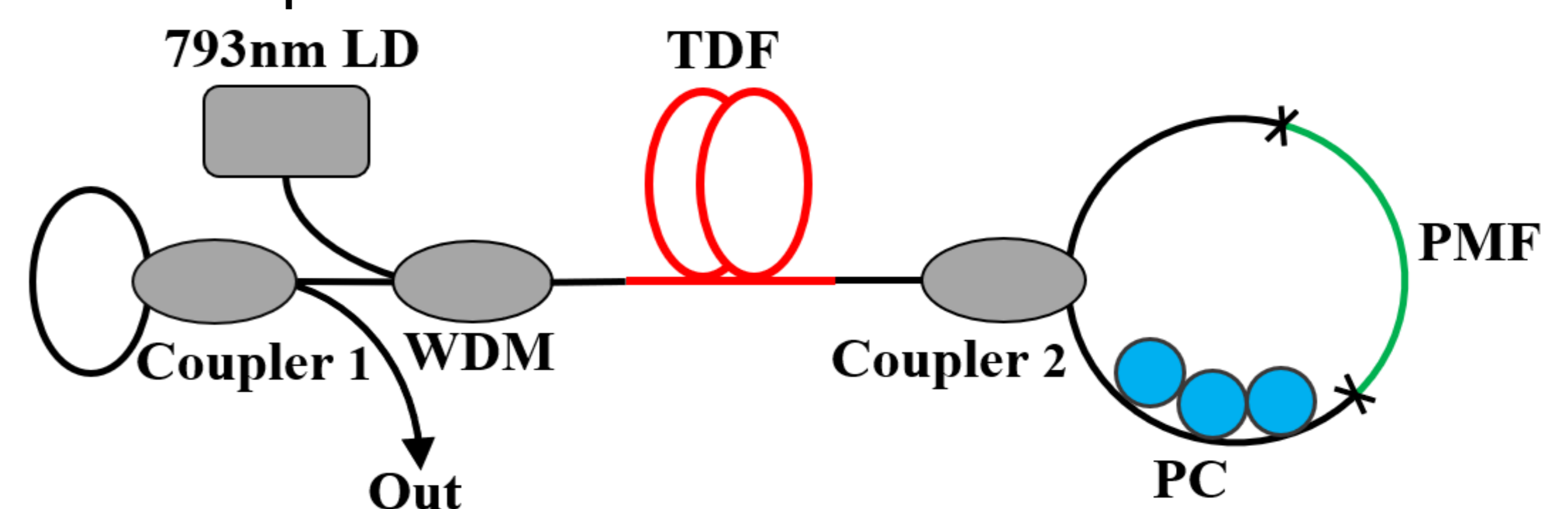


Figure 1. Experimental setup of the multi-wavelength TDFL.

3. EXPERIMENTAL RESULTS

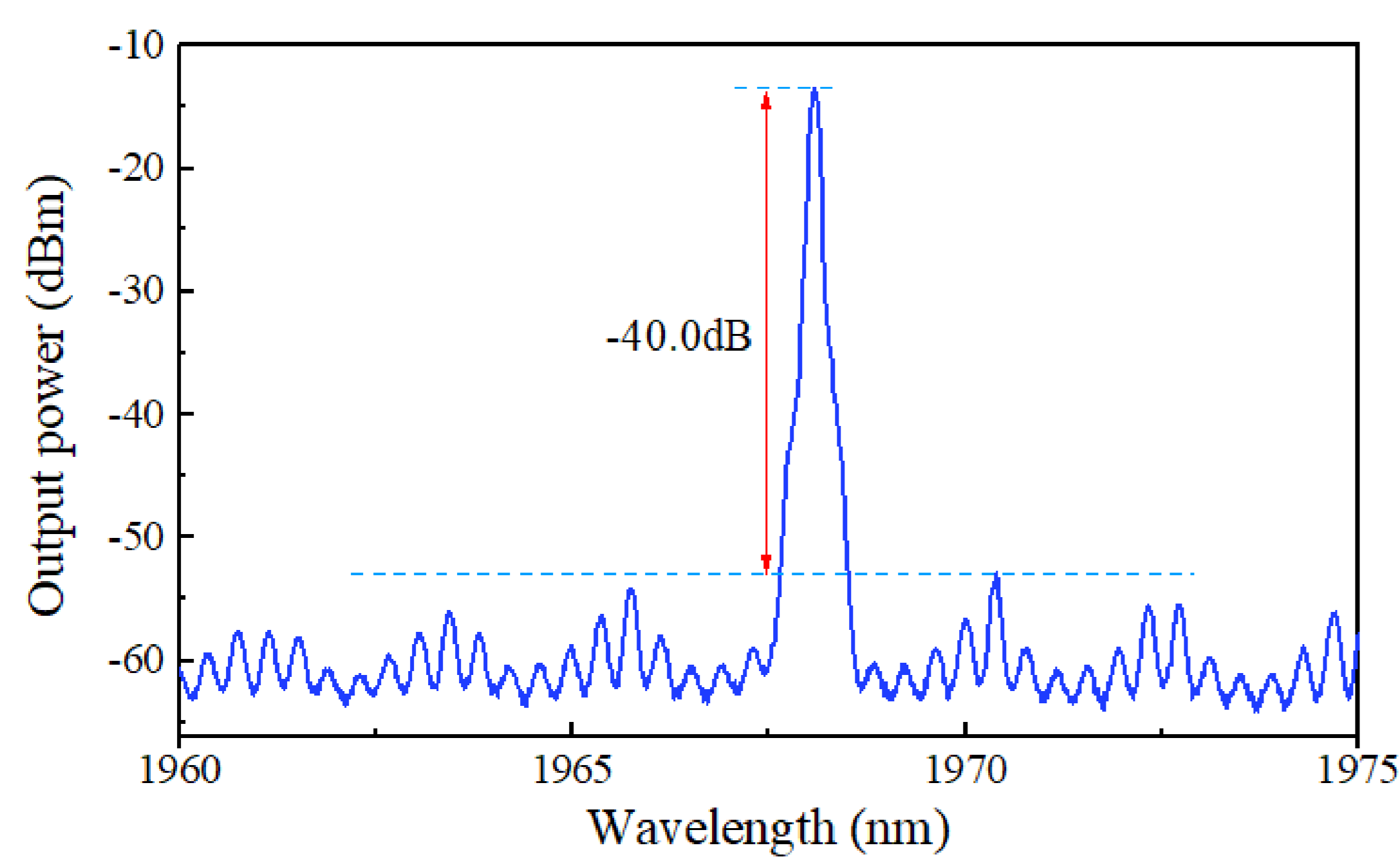


Figure 2. Output spectrum of the TDFL operating at single-wavelength.

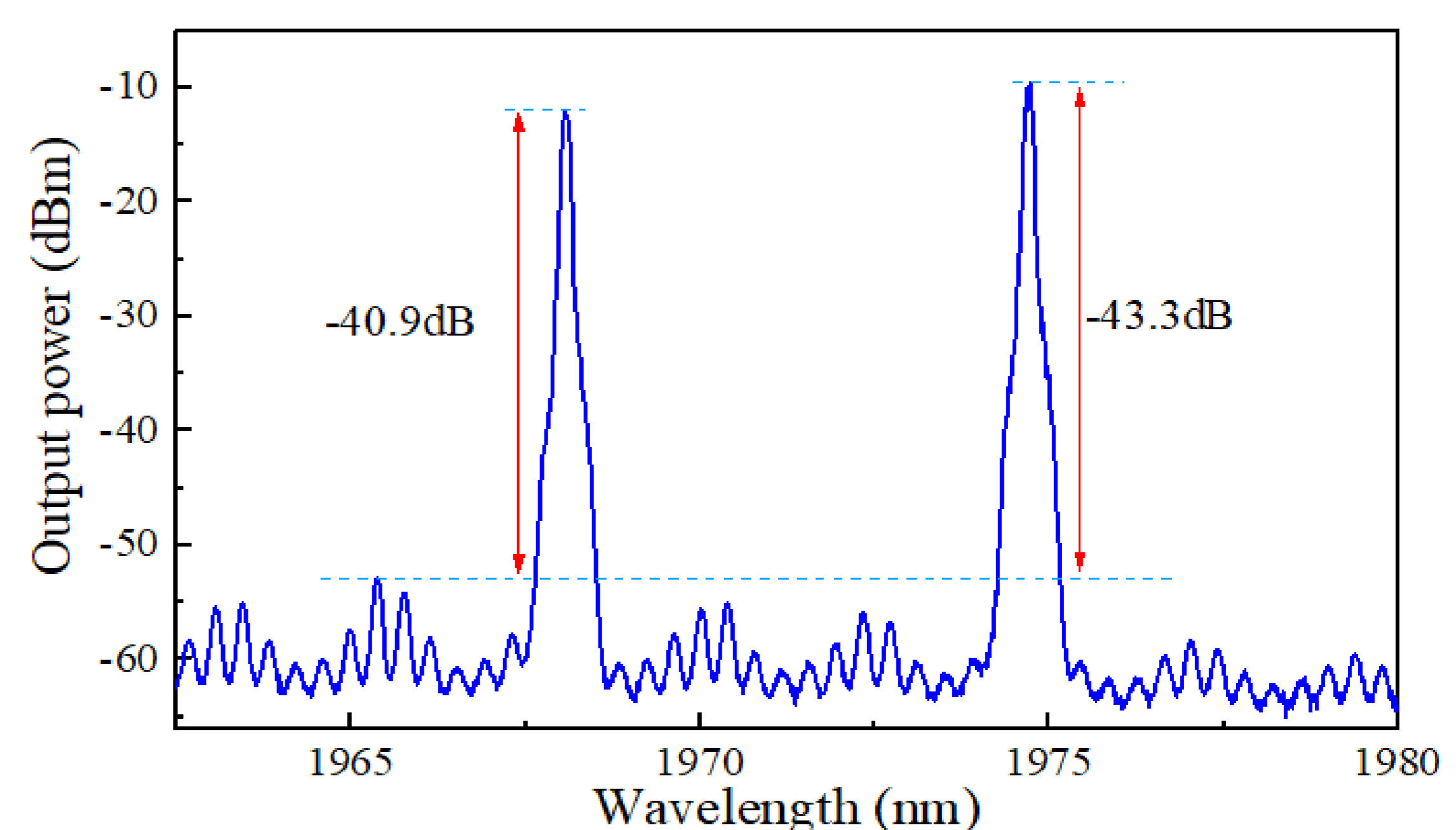


Figure 3. Output spectrum of the TDFL operating at dual-wavelength.

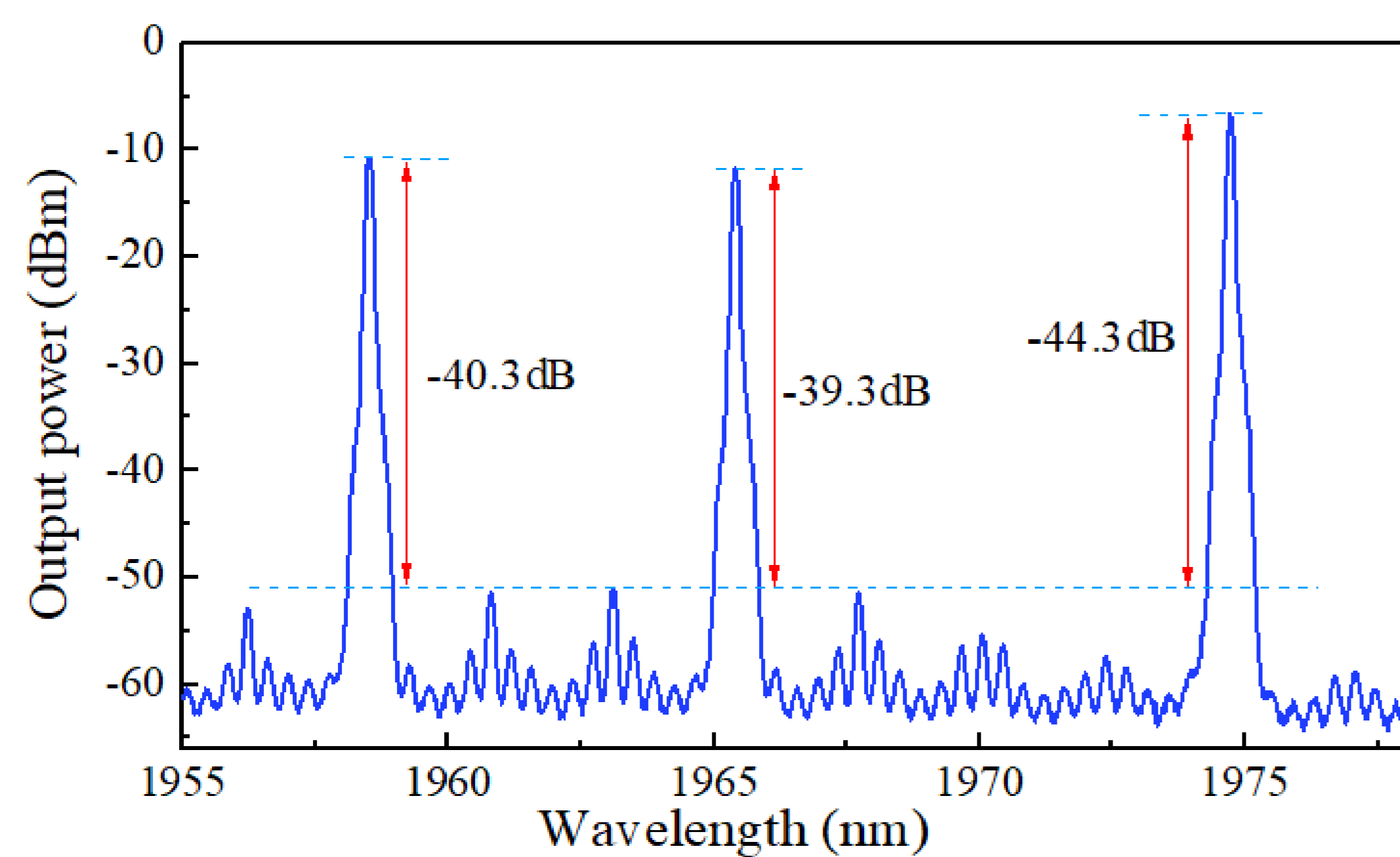


Figure 4. Output spectrum of the TDFL operating at three-wavelength.

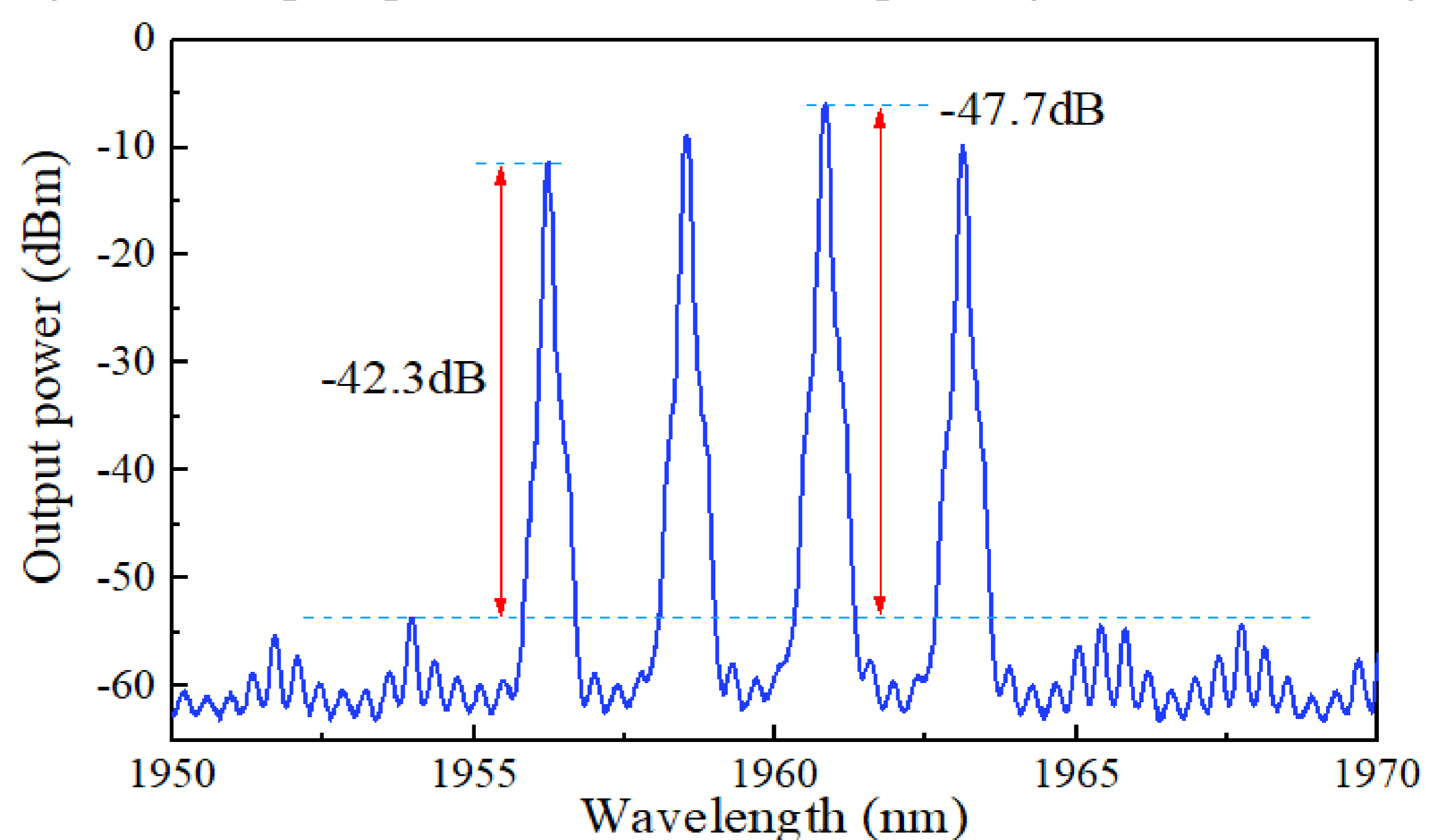


Figure 5. Output spectrum of the TDFL operating at four-wavelength.

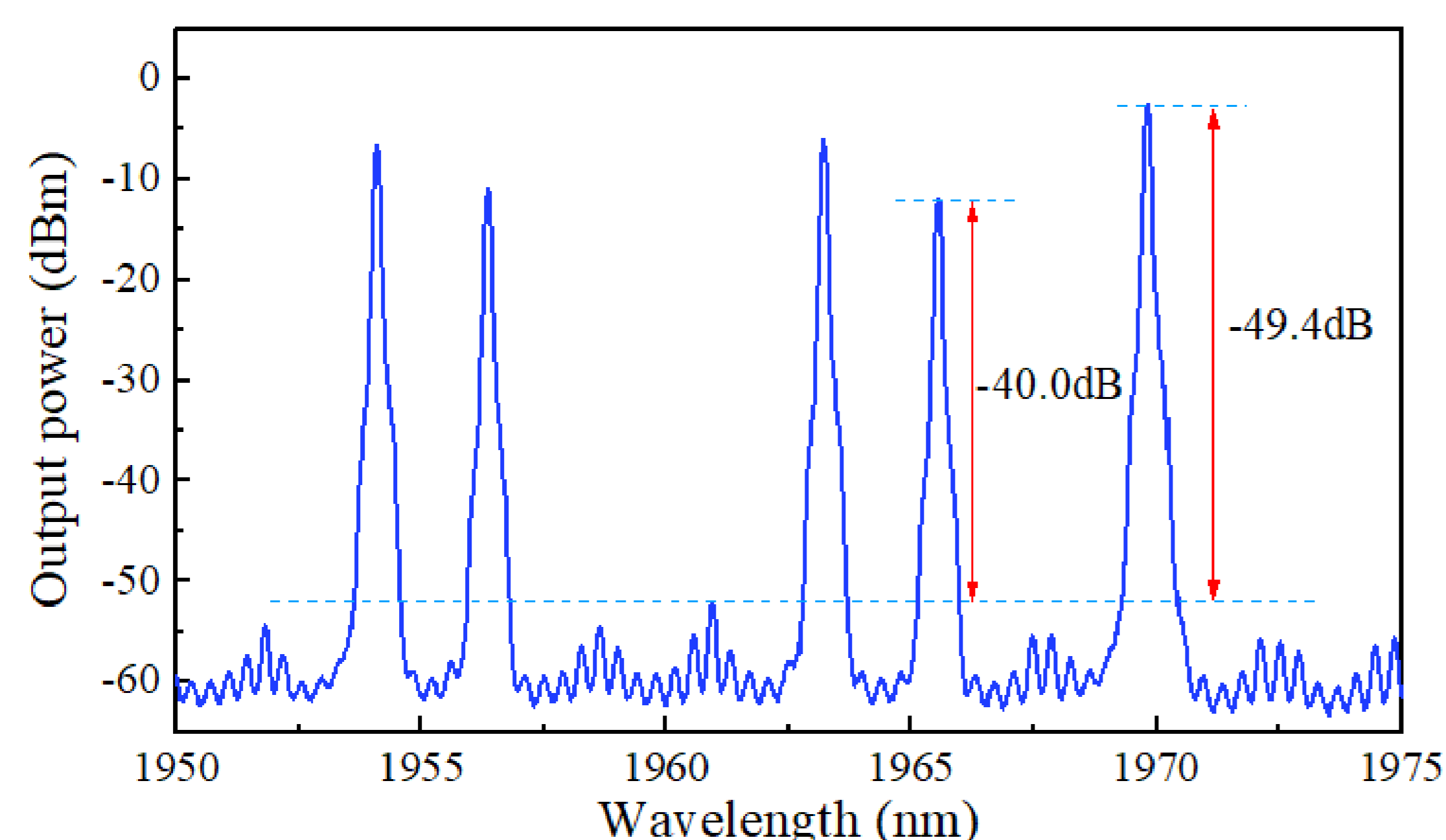


Figure 6. Output spectrum of the TDFL operating at five-wavelength.

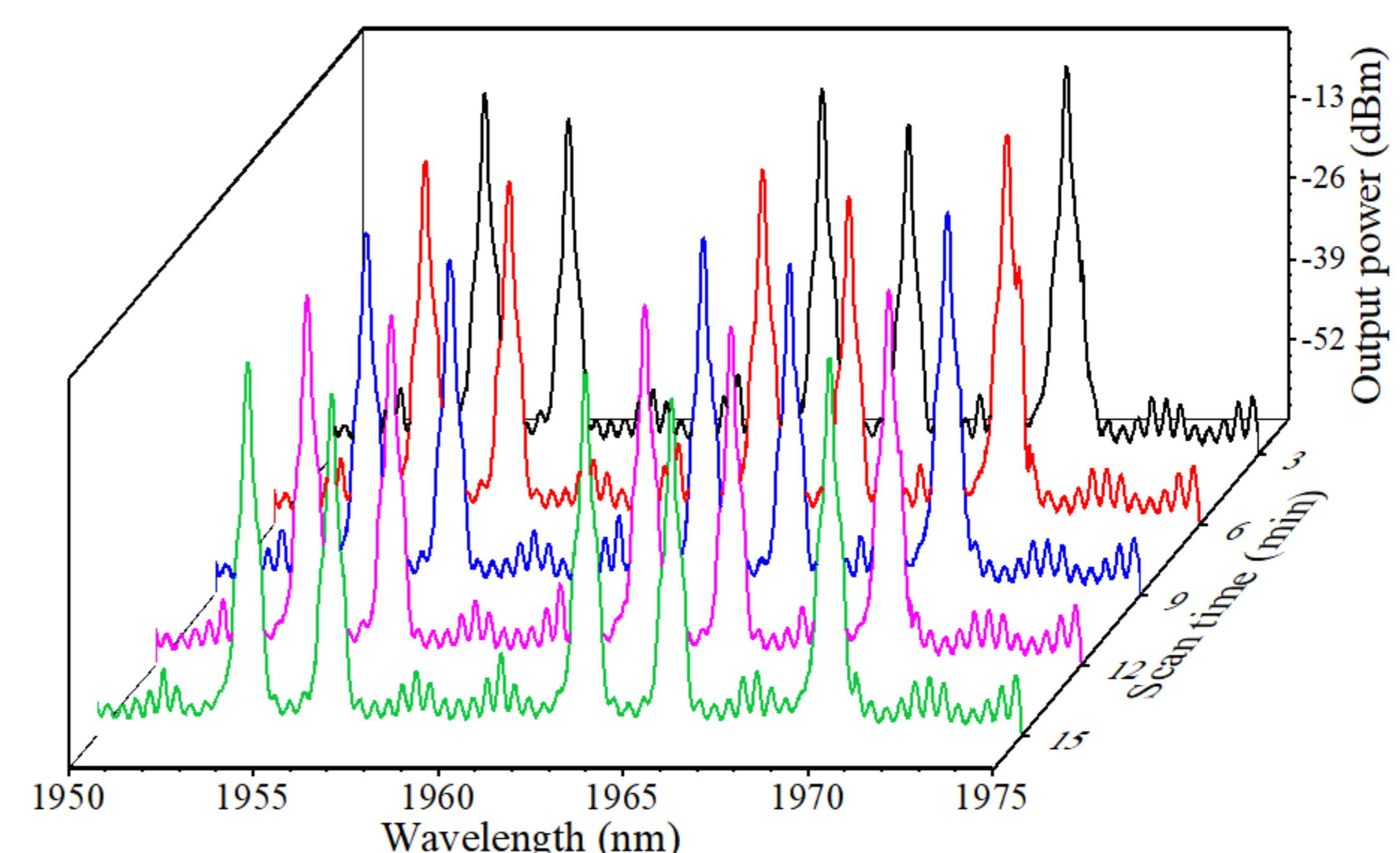


Figure 7. Stability measurement results of the five-wavelength TDFL.

4. CONCLUSION

In this work, we have demonstrated a multi-wavelength TDFL operating at 2 μm by using a Sagnac loop mirror. Stable laser outputs with single, double, three, four or five wavelengths were achieved within the spectral range between 1954 and 1975 nm. High SMSR of 40-50 dB was obtained.