A highly stable and 2.4×10^9 quality factor packaged microrod resonator

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Abstract: We demonstrate a highly stable and ultrahigh quality factor of 2.4×10^9 packaged microrod resonator in which Kerr optical frequency combs are generated to realize data transmission at total rate up to 100 Gb/s.

1. Introduction

Whispering gallery mode (WGM) microresonators have become a frontier research hotspot by virtue of high quality (Q) factor and small mode volume. Recent years, microresonators have witnessed wide applications in sensing [1], nonlinear optics [2], microwave photonics [3] and optical communications [4]. Particularly, parametric oscillation effect in microresonators is an excellent way to generate optical frequency combs (OFCs), which have attracted great interests in optical communication. However, microresonator has strict environmental requirements and difficulty to maintain stable operation for long periods of time. Moreover, it requires three-dimensional nano-positioning systems for precision coupling. All of these have limited the application and development of microresonator frequency combs.

Here, we demonstrate a packaged microrod resonator with an ultrahigh-Q of 2.4×10^9. In addition, this resonator exhibits the superior long-term stability achieved by fine temperature adjustment via a thermoelectric cooler (TEC). The OFCs are generated in this resonator based on parametric oscillation effect with a pumping threshold as low as 266 μW. As a proof-of-principle experiment, back-to-back data transmission of Non-Return-to-Zero On-Off-Keying (NRZ OOK) with rate up to 100 Gb/s is demonstrated using the OFCs. The proposed ultrahigh-Q packaged microrod resonator provides a promising platform for the optical communications, metrology and sensing.

2. Experimental Results

Fig. 1(a) shows the packaged silica microrod resonator, which is fabricated on an automated laboratory platform within one minute by precise control of the automated procedures. As shown in Fig. 1(b), the Q of the microrod

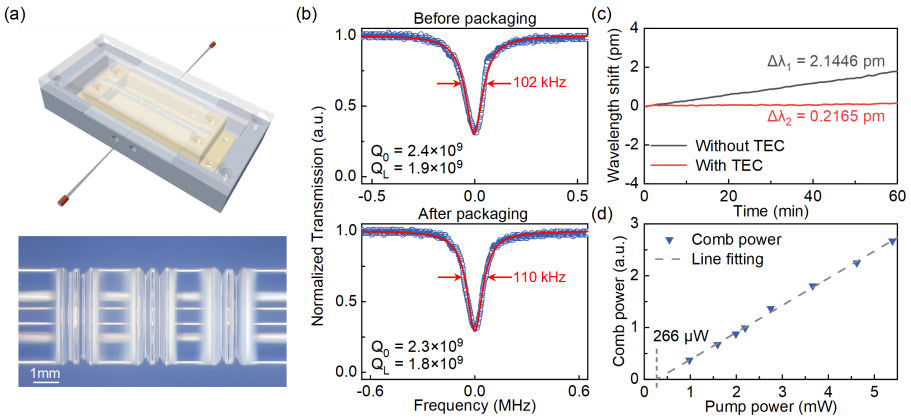

Fig. 1. (a) Top: schematic diagram of the packaged microrod resonator; bottom: optical imaging of the microrod resonator. (b) Measured greater than 2 billion Q of the microrod resonator before and after packaging. (c) The stability of the packaged microrod resonator over 1 hour without and with TEC. (d) Parametric oscillation power versus pump power showing an oscillation threshold of 266 μW.