

# Distance calibration via Newton's rings in yttrium lithium fluoride whispering gallery mode resonators

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In this work, yttrium lithium fluoride (YLF) was explored for the first time as a crystalline whispering-gallery mode resonator (WGMR). A YLF WGMR was successfully fabricated via single point turning and exhibited a high  $Q$ -factor of  $10^9$  in the near-infrared, see Fig. 1(a). Moreover, we employ a novel method based on microscopic imaging of Newton's rings through the back of a trapezoidal prism. This method can be used to evanescently couple light in to a WGMR and monitor the separation between the WGMR and the coupling prism. Accurately calibrating the distance between a coupling prism and a WGMR is desirable as it can be used to improve experimental control and conditions, i.e., accurate coupler gap calibration can aid in tuning into desired coupling regimes and can be used to avoid potential damage caused by collisions between the coupling prism and the WGMR. We used two different trapezoidal prisms together with the high- $Q$  YLF WGMR in the setup shown in Fig. 1. A YLF WGMR has the potential to generate Kerr frequency combs due to its anomalous dispersion. Furthermore, it can be readily doped with rare-earth ions, allowing for gain and dispersion tailoring.

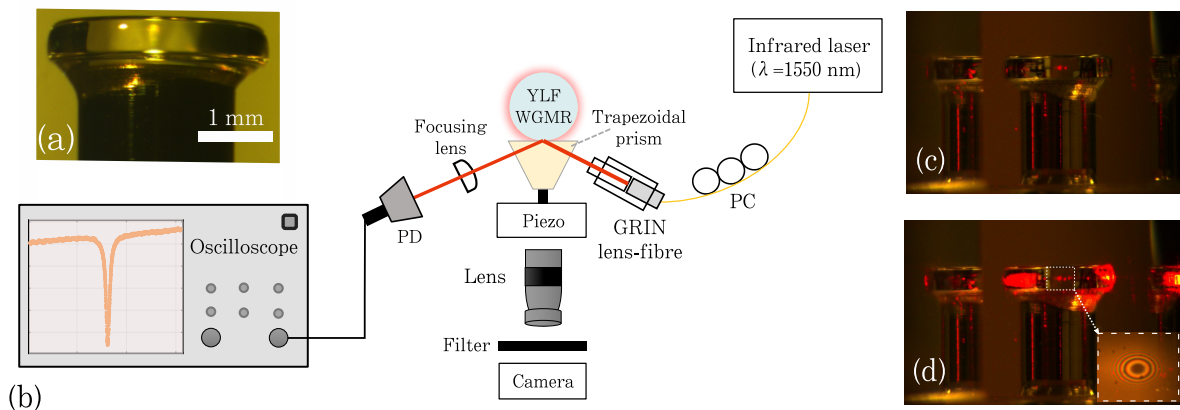


Figure 1: (a) Polished YLF WGMR after the fabrication process. (b) Experimental setup used to couple light into the YLF WGMR using a trapezoidal prism. A camera is used to observe the interference pattern formed by the WGMR and the prism. A near-IR laser is coupled in to the WGMR via GRIN lens-pigtailed fibre ferrule combo to excite the WGMs, which are observed using a PD and an oscilloscope. (c) Image of the YLF resonator seen from the back of the trapezoidal BK7 prism. The red light seen in the picture is a result of a red laser used for coupling light. (d) Image of the resonator when light is coupled inside it. Inset shows the contact region between the WGMR and the prism when the distance between them is negligible.