

Lasing and amplification in titanium doped sapphire whispering gallery mode resonator

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Titanium doped sapphire is a ubiquitous gain medium for solid state lasers. Here we present a high quality titanium doped sapphire whispering gallery mode (WGM) resonator with record low lasing threshold and high slope efficiency. We also show that amplification is readily achievable [1]. A green pump laser is evanescently coupled to the WGM resonator and we observe single mode lasing at pump powers as low as 11.2 mW. Furthermore, we also realised multi mode lasing and can report laser slope efficiencies of 34%. We directly observe the four-level gain in the system by simultaneously coupling to a near infrared mode at 795 nm and observing its linewidth decrease, as shown in Fig.1(c). Such a platform might also find use for further investigation into clockwise and anti clockwise lasing, acting as gyroscope.

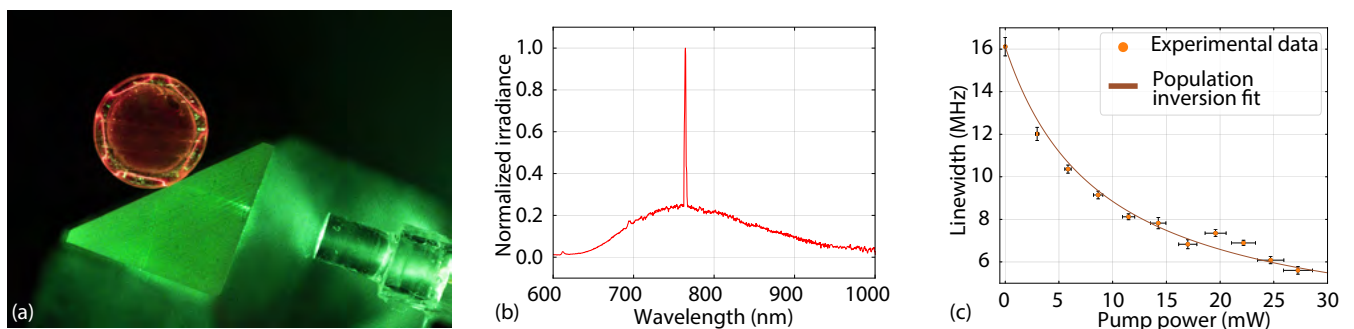


Figure 1: (a) Photograph of fluorescence in the titanium doped sapphire whispering gallery mode resonator. (b) Single mode lasing: by adjusting polarisation and coupling, lasing on various different laser lines can be achieved. (c) Amplification: The gain reduces the linewidth of a simultaneously coupled near IR laser.

[1] F. Azeem, L. S. Trainor, A. Gao, M. Isarov, D. V. Strekalov, and H. G. L. Schwefel, *Ultra-Low Threshold Titanium-Doped Sapphire Whispering-Gallery Laser*, *Advanced Optical Materials* 10, 2102137 (2022).