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Widely-tunable, doubly-resonant Raman scattering on diamond in an open microcavity

Raman lasers are a valuable resource for frequency conversion of coherent light. Diamond, in particular, is a material well-suited for Raman lasers due to the wide transparency window, high thermal conductivity and a large Raman gain. The implementation of a low-threshold Raman laser in the visible, however, remains elusive due to material and fabrication limitations. Nevertheless, nanophotonic engineering offers a viable route to reduce the pump-power threshold.

Open microcavities have emerged as versatile platform for enhancing light-matter interactions on the account of full *in situ* tunability. These cavities offer the possibility to incorporate micron-sized crystalline membranes [1], while maintaining an appreciable ratio of quality-factor to mode volume [2]. In this work, we propose to use a diamond micromembrane embedded in such an open microcavities as a novel platform for the realization of a low-threshold Raman laser [3]. We characterize the performance of the cavity and demonstrate quality-factors exceeding 100 000. We next establish a configuration with the pump laser and the Raman transition simultaneously resonant. We further demonstrate a >THz continuous tuning range of this doubly-resonant Raman scattering condition by exploiting the *in situ* tuning capability of our platform. We predict that the current platform can achieve Raman lasing in the visible with mw pump-threshold powers. Our results are generic and applies to other solid-state materials given that a high-quality membrane can be fabricated, thus paving the way for the creation of a universal low-power frequency shifter; a valuable addition to the nonlinear optics toolbox.

References

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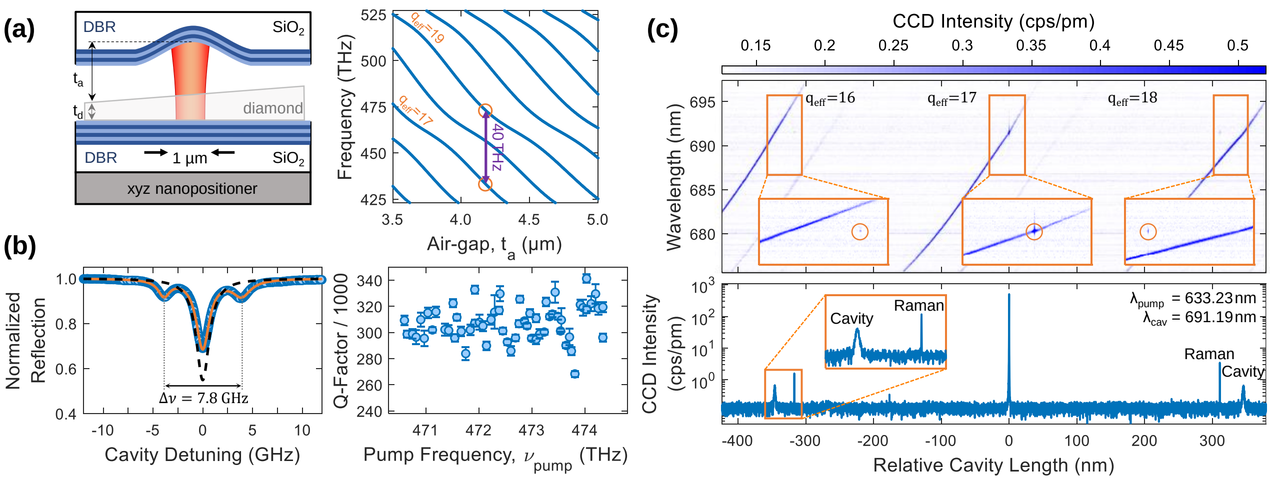

Figure 1: (a) Tunable cavity platform (left) and typical mode structure (right). (b) Characterization of the cavity performance. (c) Demonstration of the doubly-resonant configuration, with the pump laser and Raman simultaneously resonant.