Billion-*Q* microcavity photonics based on fibre preform

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Abstract: The remarkable enhancement of light-matter interactions in optical microcavities can be attributed to their high quality (*Q*) factors and small mode volumes. This unique attribute renders these devices a captivating platform for the generation of energy-efficient, innovative light sources and various photonic applications. Continuous efforts have been directed towards augmenting the *Q* factors in microcavities across diverse material platforms. However, despite advances in fabrication techniques, material absorption in microcavities still presents a fundamental limitation to the *Q* factors, thereby restricting the development of high-*Q* microcavity photonics. Here, ultrahigh-*Q* fused silica microcavities are fabricated on a high-purity fibre preform with ultralow material loss. The fundamental performance limit of the microcavity is investigated through the photothermal absorption probing method. Impressively, an ultra-low material loss of 2.02 dB/km is attained in a microcavity with an over-billion loaded *Q* factor, corresponding to a material-limited *Q* factor of 12.6 billion. The material loss is the lowest reported over the world at present [1]. With its outstanding performance, we believe that our solution could become the paradigm for the future low material absorption loss microcavities fields.

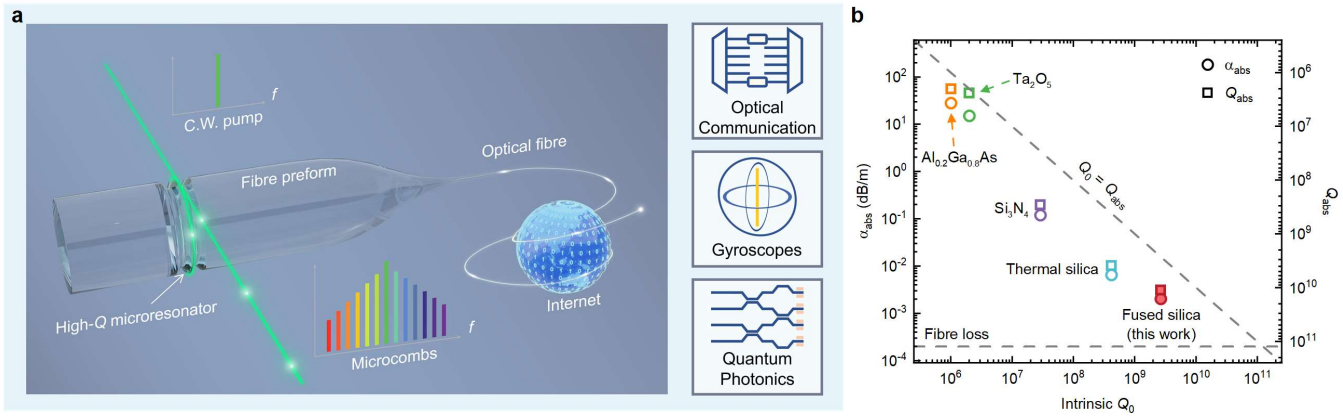

Fig. a, Ultrahigh-*Q* microcavity photonics based on fibre preform. b, Comparison of material loss in different platforms.

References:

[1] Gao, M., Yang, Q.-F., Ji, Q.-X., Wang, H., Yu, S.-P., Papp, S. B., Bowers, J. E., Kippenberg, T. J. & Vahala, K. J. "Probing material absorption and optical nonlinearity of integrated photonic materials," Nat. Commun. **13**, 3323 (2022).