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Very strong coupling and room-temperature polariton condensation with quasi-2D perovskites

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Abstract

In this study, we demonstrate widely tunable room-temperature cavity exciton polaritons at the cross-over from the strong coupling to the very strong coupling regime, in mechanically exfoliated quasi-2D Ruddlesden-Popper iodide perovskite $(BA)_2(MA)_2Pb_3I_{10}$ integrated into an open microcavity. We gradually increased the cavity length and observed a pronounced anti-crossing behavior associated with successive longitudinal cavity modes. The Rabi splitting exhibited a systematic reduction with increasing cavity length; however, the scaling behavior deviated from the conventional square root dependence typically observed in the strong coupling regime. Additionally, under strong, non-resonant optical pumping, we observe a polariton condensation and through interferometric measurements, we confirm the emergence of spatial coherence across the condensate. Our findings provide a foundation for future on-chip applications involving tunable polaritonic and nonlinear optical devices based on strongly coupled perovskite systems.