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QUANTUM OPTIC

Observation of exciton polariton condensation in a perovskite lattice at room temperature

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Exciton polariton are bosonic quasiparticles arising from the strong coupling between excitons and cavity photons. Thanks to the low effective mass inherited from their photonic components and strongly interacting bosonic nature from the constituent excitons, they are regarded as promising candidates to realize Boson-Einstein Condensation at much higher temperatures, compared with conventional atom cases. With the development of microfabrication techniques, polariton condensates can be precisely trapped in periodic potentials to form artificial lattices, which have led to a wide range of important applications, such as ultrafast simulators of the X–Y Hamiltonian, topological Chern insulators and topological lasers. However, early demonstrations mainly work with GaAs system, which are limited to liquid helium temperatures owing to the low binding energy of GaAs excitons.

Lead halide perovskites emerge as promising candidates to extend the working condition towards room temperature, thanks to their large exciton binding energy, strong oscillator strength, high quantum yield and an ease of fabrication. Stable exciton polariton condensation and long-range conherent polariton condensate flow in perovskite microcavities at room temperature have been demonstrated by the research team of Prof. Qihua Xiong from Nanyang Technological University. Recently, they further realized exciton polariton condensation in a one-dimensional strong lead halide perovskite lattice at room temperature. Modulated by deep periodic potentials, the strong lead halide perovskite lattice exhibits a large forbidden bandgap opening up to 13.3 meV and a lattice band up to 8.5 meV wide (Fig. 1), which are at least 10 times larger than previous systems. Above a critical density, exciton polaritons condense into p_y orbital states with long-range spatial coherence at room temperature. Their results pave the way to implement artificial polariton lattices for quantum simulation and topology at room temperature.

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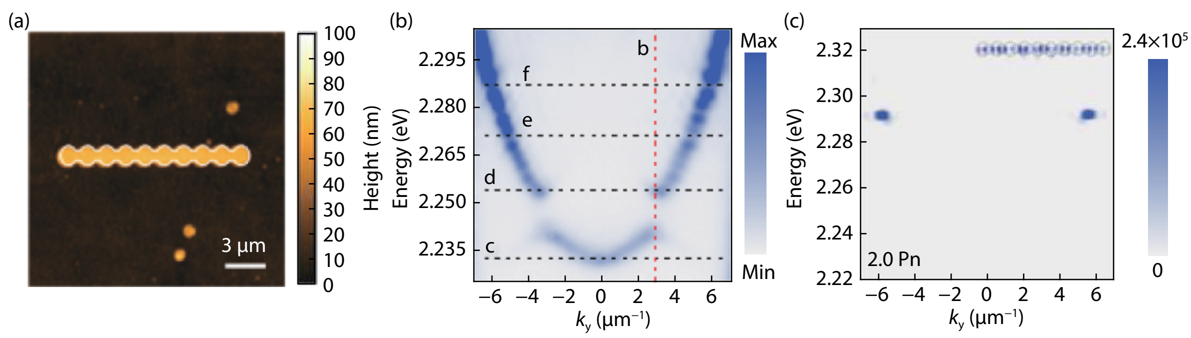

Fig. 1. (Color online) (a) Atomic microscopy image of the perovskite lattice. (b) Energy-resolved dispersion of the perovskite lattice below the threshold. (c) Energy-resolved dispersion of the perovskite lattice above the threshold. Inset, the real space image above the threshold, showing clear p_y orbital state feature.