# Polaritonic source modulation via topological junction metasurfaces

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Exciton polaritons are unique quasi-particles that combine light and matter, offering promising potential for next-generation optoelectronic devices. In this study, we leverage the combined advantages of room-temperature perovskite excitons and topological photonic structures to demonstrate topological exciton polaritons with robust light confinement in organic-inorganic hybrid perovskite thin films. By combining two topologically distinct gratings, a new topological junction state is created at their interface [1]. Our findings reveal targeted enhancement effects, including perpendicular narrow-beam polariton emission from a tightly localized junction area, increased polaritonic nonlinearity, and enhanced photoluminescence (PL). These exceptional properties are achieved using compact devices with widths of just a few micrometers, which can be precisely tailored by adjusting the unit-cell geometry. Therefore, the proposed approach provides a versatile platform for room-temperature topological exciton polaritons and their potential applications in advanced optoelectronic devices.

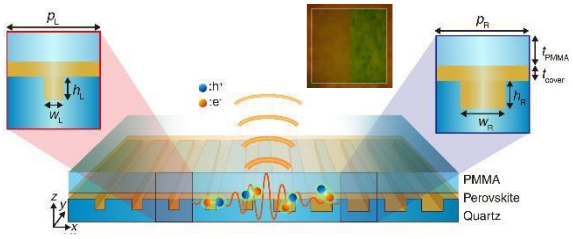


Fig. 1. Structure of topological junction.

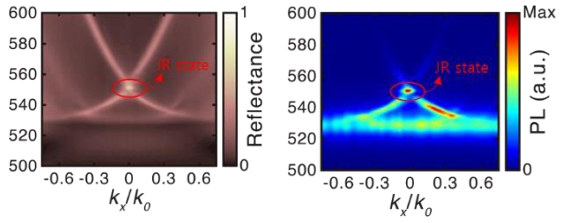


Fig. 2. Reflection and PL.

We fabricated the samples by etching quartz substrates and then spin-coating them with perovskite, as shown in Fig. 1. By varying the width of the dielectric perovskite gratings, we achieved different topological bands. These distinct bands enable the formation of a spot-like Jackiw-Rebbi (JR) state within the bandgap at $k_x = 0$, resulting in normal-directional beaming with low divergence (Fig. 2). When the perovskite is excited by a pumping laser, it generates excitons that couple with the topological photonic structure, forming exciton-polaritons. These exciton-polaritons exhibit a blue shift as the pumping power increases, which is attributed to nonlinear effects. The directional pattern of the topological beaming can be controlled by modulating the Dirac mass of each grating. Additionally, by breaking symmetry to create chirality, we expect that the polarization of the topological beaming can be effectively modulated.

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