Large-scale Perovskite Microwires of Arbitrarily Shape for Room Temperature Polaritonic Circuitry

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The quest for material platforms that offer a cost-effective, easily fabricated, and nonlinear device working at room temperature poses a significant challenge in today's photonics. In this context, we invented a versatile method for creating perovskite polariton waveguides of arbitrarily predesigned shapes[1]. Our waveguides, composed of $CsPbBr_3$ monocrystals, possess the unique ability to bend without compromising optical quality, allowing the creation of polariton couplers, beamsplitters, and interferometers. Moreover, structures can be deposited on various substrates, enhancing compatibility with existing photonic devices. Notably, our method addresses the drawbacks of conventional waveguiding setups by eliminating the need for external cavity mirrors. This approach improves the fabrication process, making on-chip polaritonic devices more accessible and cost-effective. These structures exhibit the ability to guide waves and support the formation of spatially extended condensates of coherent exciton-polaritons (see FIG.1). We demonstrate polariton lasing occurring at the interfaces and corners of the microwires, with substantial blueshifts observed under excitation power. The high mutual coherence between different lasing signals at edges and corners, as evidenced in far-field photoluminescence and angle-resolved spectroscopy, indicates the formation of a coherent polariton condensate. This condensate can propagate over long distances within the wires and even couple between neighboring wires through air gaps. Thanks to the optical properties of the perovskite used, we also observe a polarization flip during the propagation of the condensate. The simplicity and scalability of our platform, coupled with its compatibility with standard photonic components, set the stage for future large-scale, integrated polaritonic circuitry. Our findings not only underscore the potential of $CsPbBr_3$ perovskites in photonic applications but also provide a more accessible path for developing advanced on-chip optical devices with built-in nonlinearities.

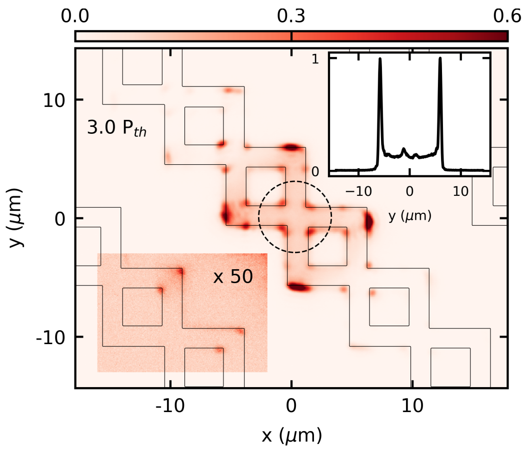

Figure 1: Polariton edge lasing of perovskite structure marked by black contours. Pump spot is located at (0,0) and inset plot shows cross-section at $x = 0$.

[1] M. Kedziora et al. *Arbitrarily predesigned perovskite crystal waveguides for room temperature exciton-polariton condensation and edge-lasing*, **2023**, under review.