All-inorganic perovskite quantum dots: a fundamental building block for optical neuromorphic synapse devices

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Here we present our recent advancements in the development of multifunctional optoelectronic devices based on allinorganic perovskite ($CsPbBr_3$) quantum dots (QDs). We first demonstrate a dual mode device capable of operating either as an optical sensor or as an artificial synapse, with its functionality determined by the applied electrical polarity [1, 2]. This represents a significant step toward the realization of the first homogeneously integrated synaptic device based on perovskite QDs. Our device offers direct evidence that colored image recognition and nearsensor computation can be achieved within a unified and compact architecture. In addition, we present a resonantly enhanced photodetector with builtin color selectivity, achieved via monolithic integration of $CsPbBr_3$ QDs into a Tamm plasmon (TP) structure [3, 4]. Due to its narrow spectral response, the proposed device exhibits synaptic dynamics, multilevel conductance modulation in response to repetitive light stimuli at the resonant wavelength, enabling key neuromorphic functions such as colordependent memory encoding and visual perception. These findings collectively represent a substantial advancement in neuromorphic computing platforms and open a new horizon for allinorganic perovskite optoelectronic technologies.

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