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Low Temperature Raman and Photoluminescence of Tyramine-based Lead Iodide Perovskite

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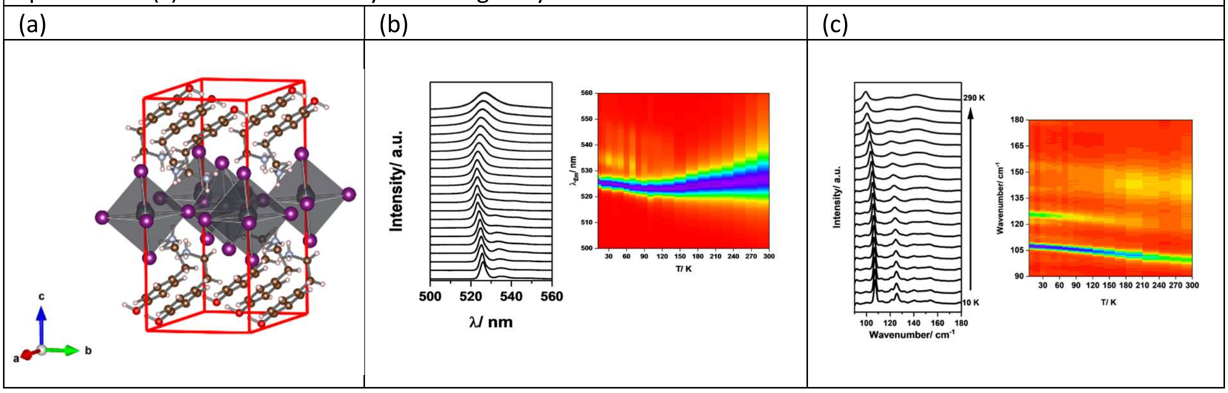
Semiconductor 2D hybrid perovskites (2DHPs) have attracted significant attention owing to their natural quantum-well structure, which holds promise for optoelectronic device applications. This study focuses on tuning of the excitonic optical properties in a single crystal of Tyr2PbI4 (Tyr = tyramine) by introducing an electron-donating group. We investigated the influence of such insertion on the intermolecular interactions and the distortion effects in the [PbI6]4- octahedra. Single-crystal X-ray diffraction (SXRD) (Fig. 1.a) confirms the Ruddlesden-Popper phase, crystallizing in the triclinic space group P-1 (a = 8.6874(2) Å; b = 8.6890(2) Å; c = 17.1275(5) Å; α = 93. 540(10)°; β = 101.5230(10)°; γ = 90.1290(10°). Photoluminescence experiments (Fig. 1. b) conducted over a low-temperature range (290–10 K) reveal outstandings exciton recombinations and self-trapped exciton mechanisms. Raman spectroscopy (Fig. 1.c) shows a redshift and a separation in number of Raman modes, indicating reduced electron-phonon interactions, attributed to diminished hydrogen-bond interactions and reduced distortion in the octahedral chains. Such features highlight the key role played by the structure and its intermolecular interactions for the optoelectronic properties of this material.

Figure 1. (a) Unit cell representation for Ruddlesden- Popper Tyr_2PbI_4. Temperature-dependent (b) Raman spectra and (c) PL emissions of Tyr_2PbI_4 single crystal.


(a) (b) (c)

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