Supplementary Information

Sn-Doping Induced Lattice Distortion and Deep-Red Self-Trapped Exciton Emission in 2D Lead Perovskites

Yiqiang Xiao[a//], *Qingjing Zeng*[a//], *Wenjuan Ma*[a], *Di Wang*[a], *Yuyuan Lai*[a], *Zhiming Lin*[a], *Qi Zhang*[b], *Long Xu*[*a], *Sheng Yang*[*c] *and Qixing Wang*[*a,d]

[a]Department of Physics, College of Physical Science and Technology, Xiamen University, Xiamen 361005, China;

[b]School of Physics and Key Laboratory of MEMS of the Ministry of Education, Southeast University, Nanjing, China;

[c]Frontiers Science Center for Transformative Molecules, School of Chemistry and Chemical Engineering, Shanghai Jiao Tong University, Shanghai 200240, China;

[d]Jiujiang Research Institute, Xiamen University, Jiujiang 332000, China;

[//]These authors contributed equally to this work.

Corresponding author: Long Xu (Email: xulong@xmu.edu.cn), Sheng Yang (Email: sheng.yang@sjtu.edu.cn), and Qixing Wang (Email: phyqxw@xmu.edu.cn)

Supplementary sections

S1. Morphology and thickness characterization of a Sn-doped PEPI flake

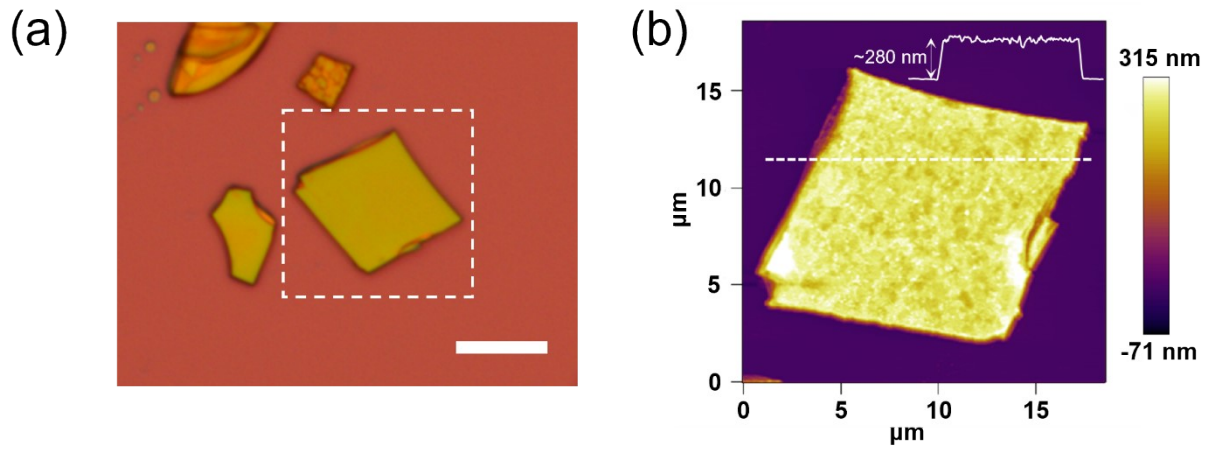

Fig. S1 (a) Optical microscopy image of Sn-doped PEPI flakes. The white dashed box marks the AFM scanning area. Scale bar: 10 µm. (b) Corresponding AFM height image. The inset shows the height profile extracted along the white dashed line, indicating the flake thickness of approximately 280 nm.

S2. Temperature-dependent emission intensity ratio

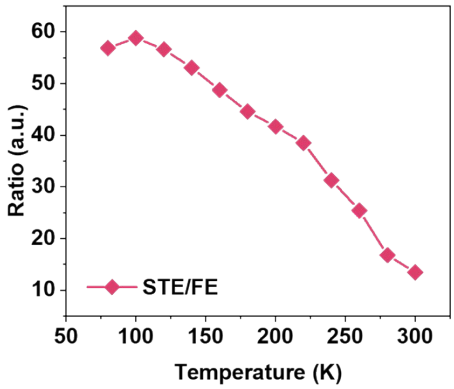

Fig. S2 Integrated intensity ratio of STE to FE as a function of temperature from 80 K to 300 K.

S3. Temperature dependence of emission peak positions

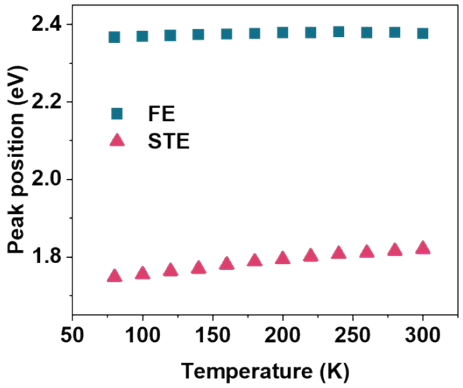

Fig. S3 Emission peak energies of FE and STE as a function of temperature.

S4. Frequency response characteristics of the BLED

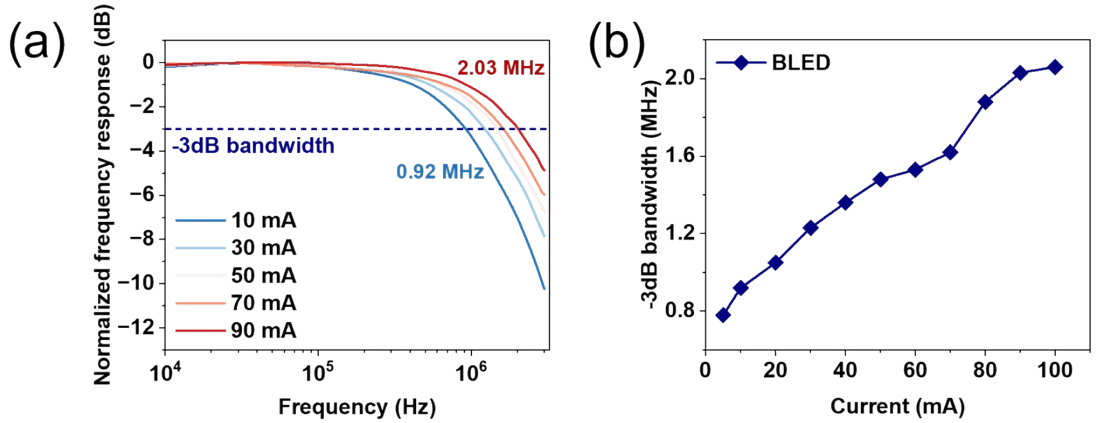

Fig. S4 (a) Frequency response of the BLED under various driving currents from 10 mA to 90 mA. The blue dashed line indicates the -3dB bandwidth level. The -3dB bandwidths for 10 mA and 90 mA are labeled as 0.92 MHz and 2.03 MHz, respectively. (b) The -3dB bandwidth as a function of driving current. The AC modulation voltage is a 400 mV_{pp} sine wave.

S5. Response waveforms of the BLED

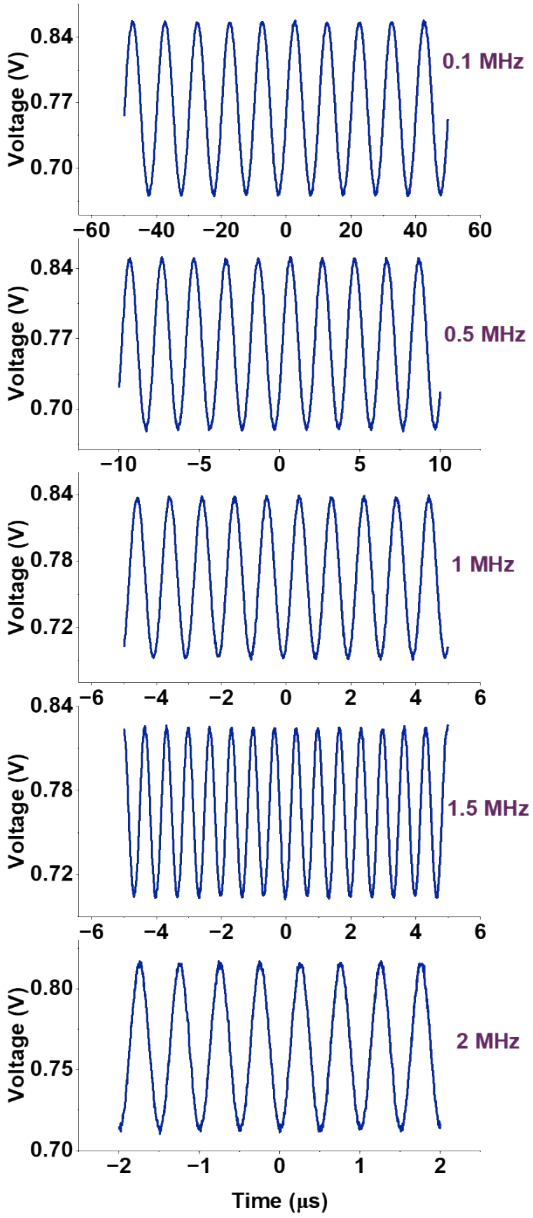

Fig. S5 Response waveforms of the BLED with a 30 mA driving current under sinusoidal modulation (400 mV_{pp}) from an AWG at frequencies of 0.1 MHz, 0.5 MHz, 1 MHz, 1.5 MHz, and 2 MHz.

S6. Response waveforms of the PEPI+BLED

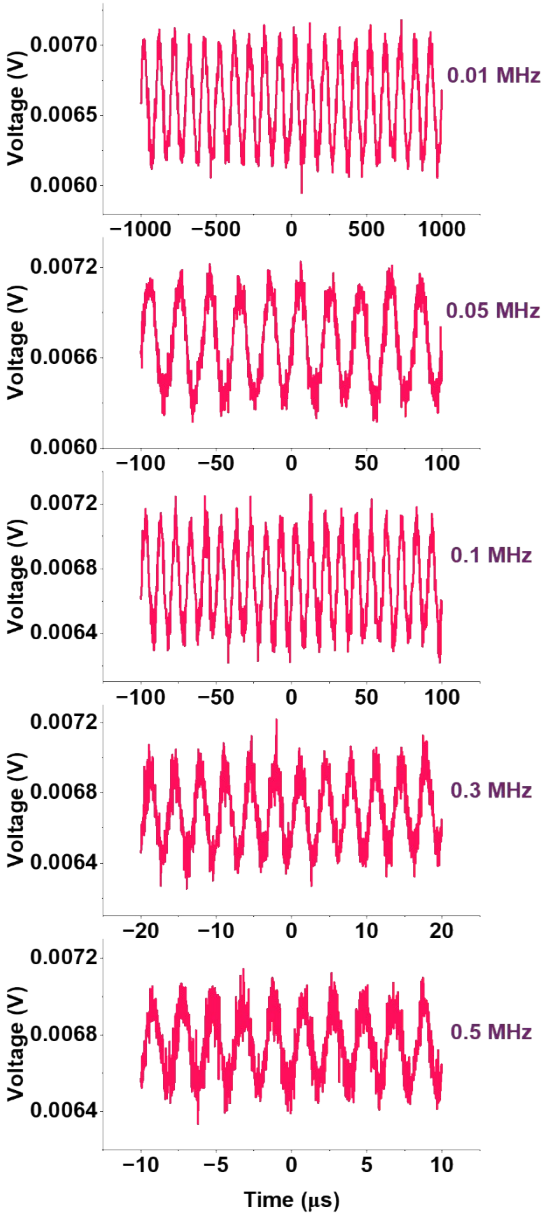

Fig. S6 Response waveforms of the PEPI+BLED with a 30 mA driving current under sinusoidal modulation (400 mV_{pp}) from an AWG at frequencies of 0.01 MHz, 0.05 MHz, 0.1 MHz, 0.3 MHz, and 0.5 MHz.