Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Pure Bromide-Based Inorganic Perovskite Sky-Blue Light-Emitting Diodes through Phase Control by NiO_x Anode Interface

Kai Sun, [ab] Zhiqiang Bao, [ab] Xiaoyang Guo,*[a] Jianfeng Ou,[ab] Ying Lv,[a] Deyue Zou,[ab] Li Song,*[c] Yantao Li,[a] Xingyuan Liu[a], Jingqiu Liang*[a]

[a]State Key Laboratory of Luminescence and Applications, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun 130033, China

[b]University of Chinese Academy of Sciences, Beijing 100049, China

[c]Tianjin Key Laboratory of Electronic Materials and Devices, School of Electronics and Information Engineering, Hebei University of Technology, 5340 Xiping Road, Tianjin 300401, P. R. China

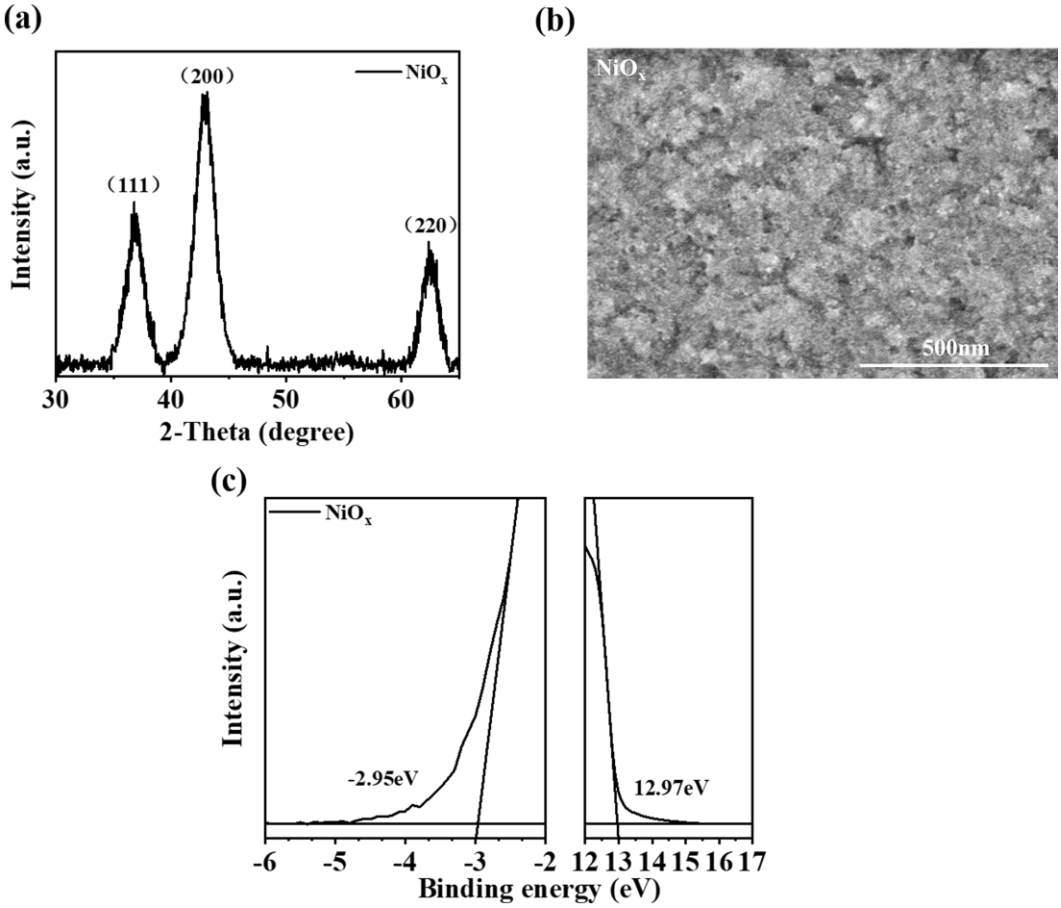

Figure S1. (a) XRD patterns, (b) SEM image, and (c) UPS of NiO_x film.

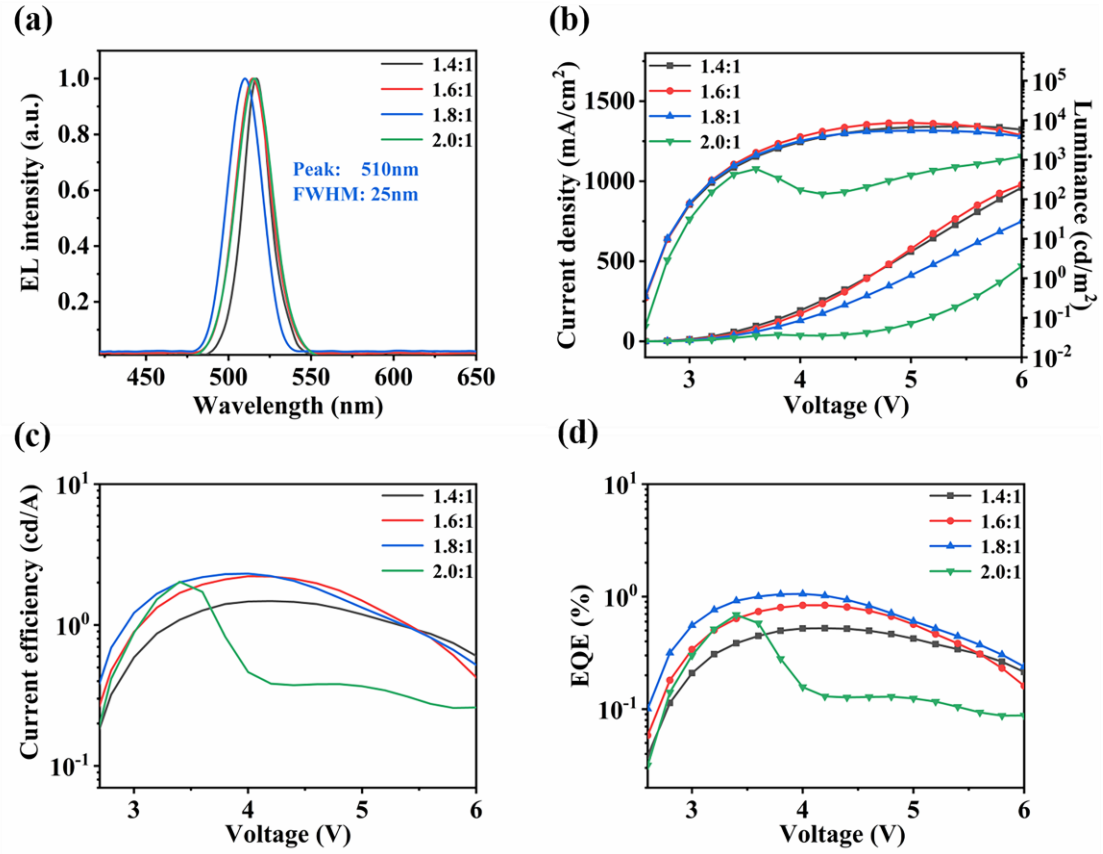

Figure S2. (a) Normalized EL spectra, (b) J-V-L, (c) CE-V, and (d) EQE-V curves of PeLEDs based on PEDOT: PSS with different CsBr:$PbBr_2$ molar ratios of 1.4:1, 1.6:1, 1.8:1, and 2.0:1.

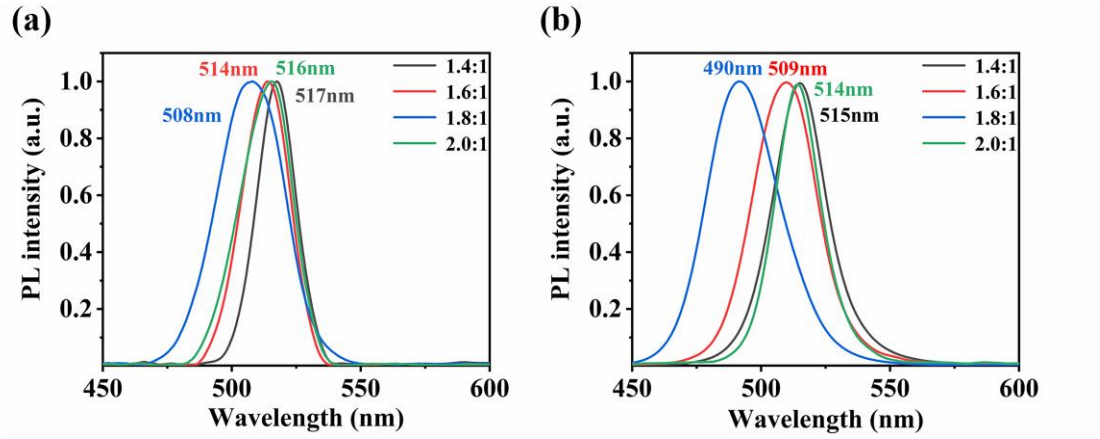

Figure S3. PL spectra of devices with different CsBr:$PbBr_2$ molar ratios of 1.4:1, 1.6:1, 1.8:1, and 2.0:1 based on (a) PEDOT: PSS and (b) NiO_x hole transport layers respectively.

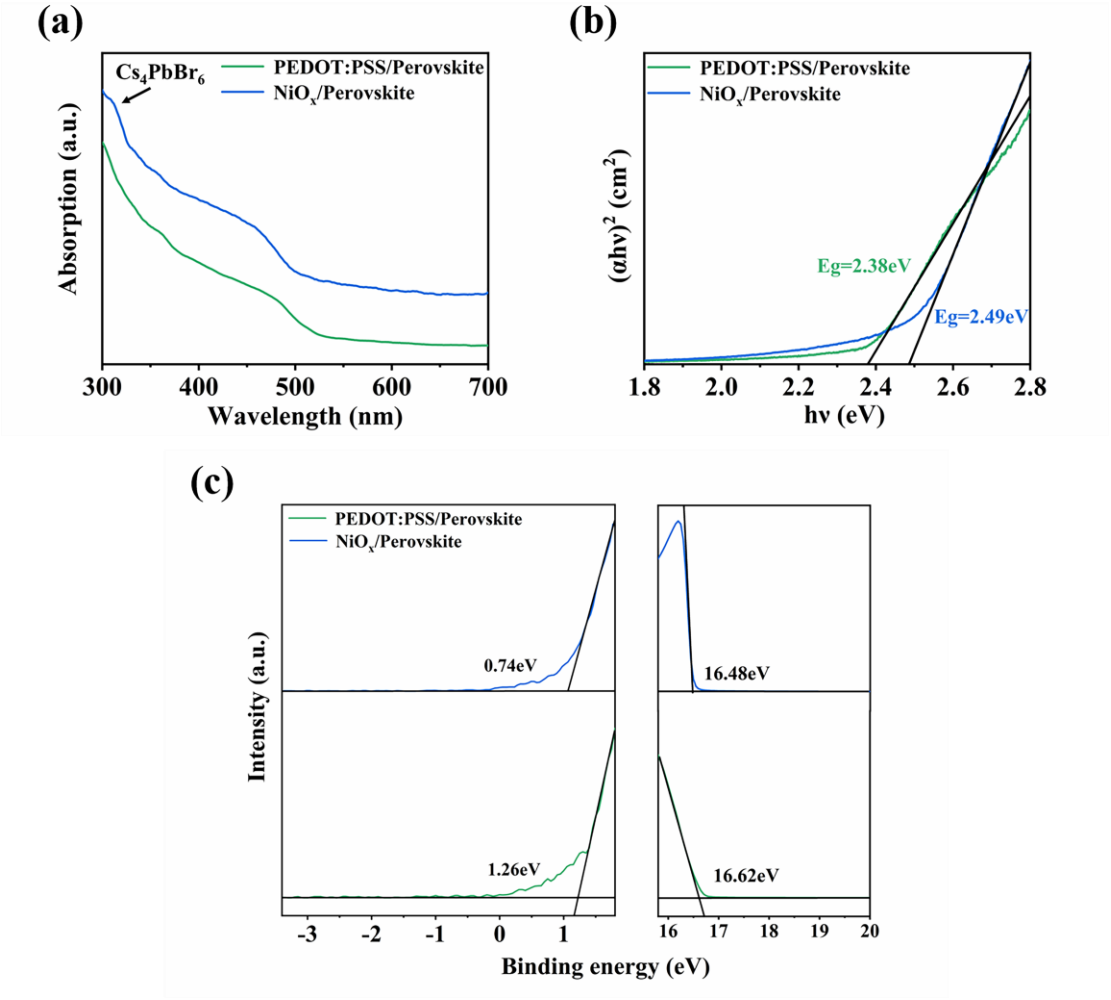

Figure S4. (a) Absorption, (b) Tauc plots and (c) UPS spectra of perovskite films with $CsBr:PbBr_2$ molar ratio of 1.8:1 deposited on PEDOT: PSS and NiO_x, respectively.

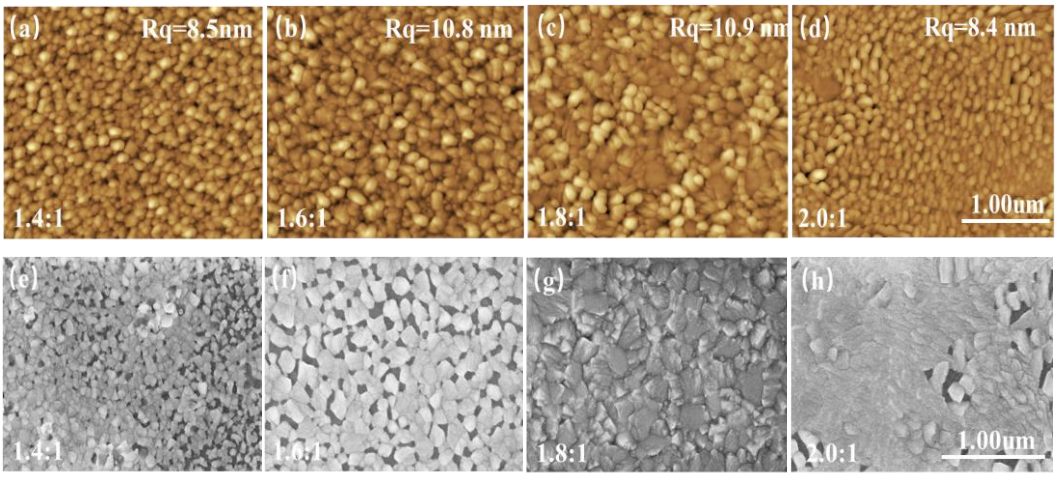

Figure S5. (a)–(d) AFM, and (e)–(h) SEM images of of perovskite films deposited on PEDOT: PSS with different CsBr:$PbBr_2$ molar ratio.

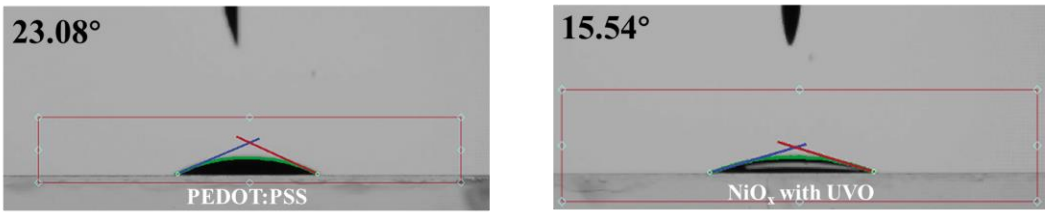

Figure S6. Contact angles of perovskite precursor solution droplets on (a) PEDOT: PSS and (b) NiO_x films, respectively.

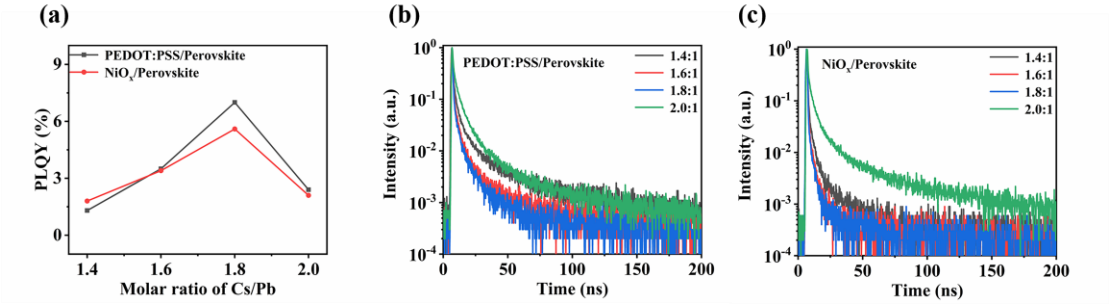

Figure S7. (a) PLQY of perovskite films with different CsBr:$PbBr_2$ molar ratio. TRPL decay curves of the perovskite films with different CsBr:$PbBr_2$ molar ratio deposited on (b) PEDOT: PSS and (c) NiO_x, respectively.

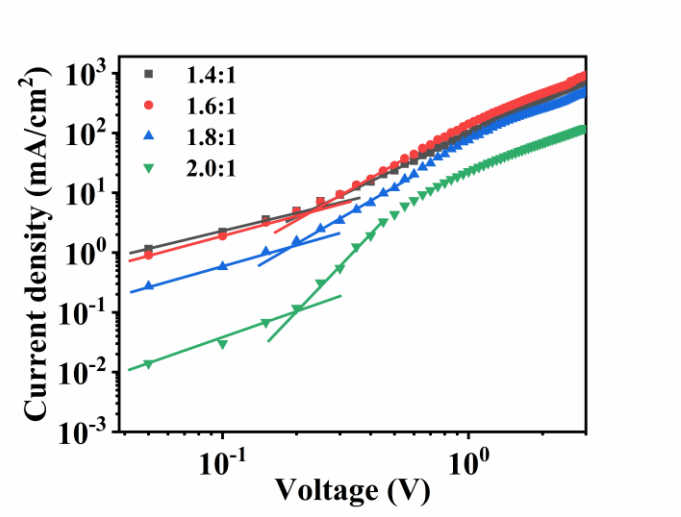

Figure S8. J-V curves of hole-only devices with different CsBr:$PbBr_2$ molar ratios.

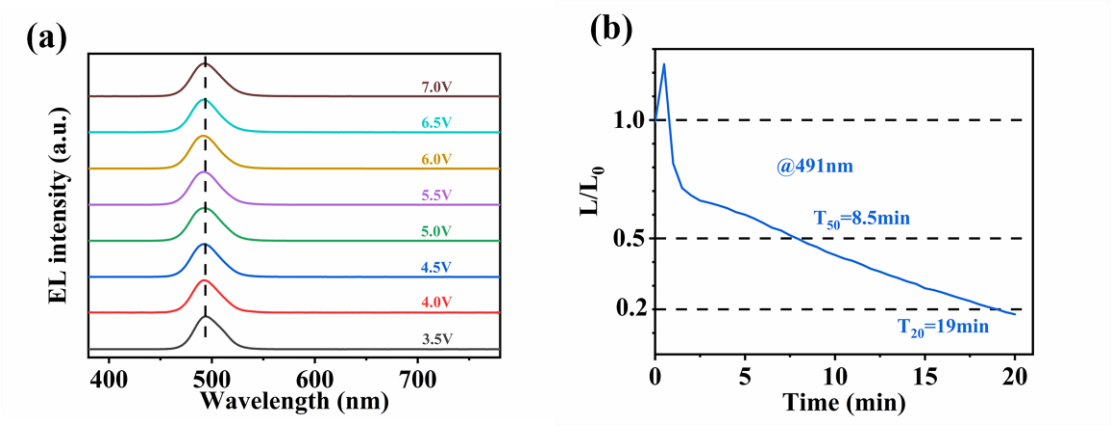

Figure S9. (a) EL spectra of the blue PeLED at different voltages. (b) Operational lifetime of the blue PeLED with an initial luminance of 100 cd/m^2.

Table S1. Summary of the optoelectronic properties of the devices fabricated.

Structure	EL (nm)	FWHM (nm)	L (cd/m^2)	CE （cd/A）	EQE
PEDOT:PSS/ 1.4:1	517	19	7020	1.48	0.52
PEDOT:PSS / 1.6:1	515	26	8640	2.22	0.84
PEDOT:PSS / 1.8:1	510	25	5470	2.32	1.05
PEDOT:PSS / 2.0:1	516	26	1380	2.03	0.69

Table S2. Summary of PLQY, PL lifetime, K_r and K_{nr} of the perovskite films with different CsBr : $PbBr_2$ molar ratios.

PLQY (%)	**1.4:1**	**1.6:1**	**1.8:1**	**2.0:1**
PEDOT:PSS	1.3	3.5	7.0	2.4
NiO_x	1.8	3.4	5.6	2.1
PL lifetime (ns)				
PEDOT:PSS	8.1	4.5	3.5	8.2
NiO_x	2.7	2.1	1.6	9.8
k_r (s^{-1})				
PEDOT:PSS	1.6×10^6	7.8×10^6	2.0×10^7	2.9×10^6
NiO_x	6.7×10^6	1.6×10^7	3.5×10^7	2.1×10^6
k_{nr} (s^{-1})				
PEDOT:PSS	1.2×10^8	2.1×10^8	2.7×10^8	1.2×10^8
NiO_x	3.6×10^8	4.6×10^8	5.9×10^8	1.0×10^8

Table S3. Summary of the trap density of the perovskite films on NiO_x.

	1.4:1	1.6:1	1.8:1	2.0:1
V_{TFL}(V)	0.23	0.22	0.19	0.20
$N_{defects}$(cm^{-3})	1.16×10^{17}	1.11×10^{17}	9.61×10^{16}	1×10^{17}