

Supplementary Information

Interfacial degradation mechanism in inverted perovskite solar cells with sol-gel derived NiO_x hole transport layer

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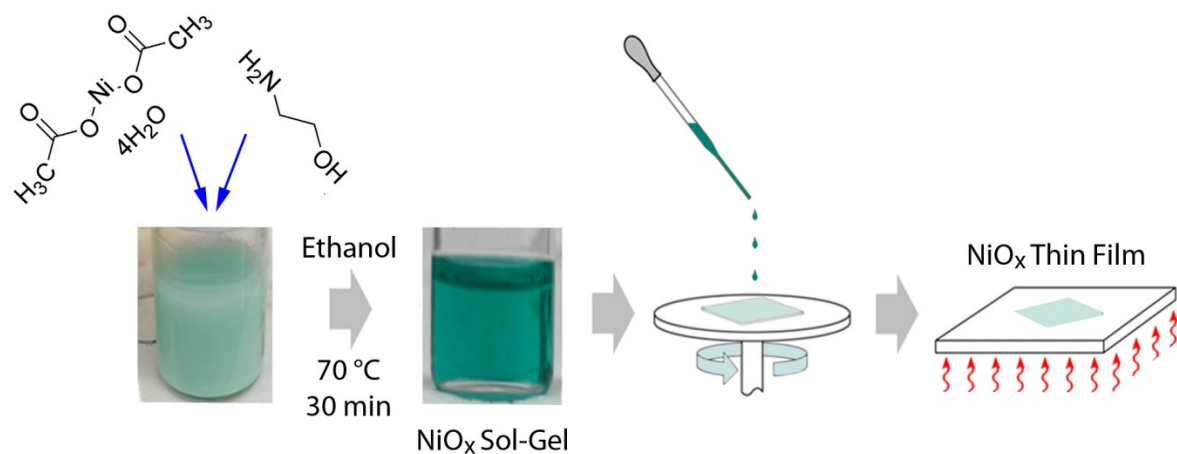


Figure S1. Synthesis pathway of NiO_x sol-gel and thin films

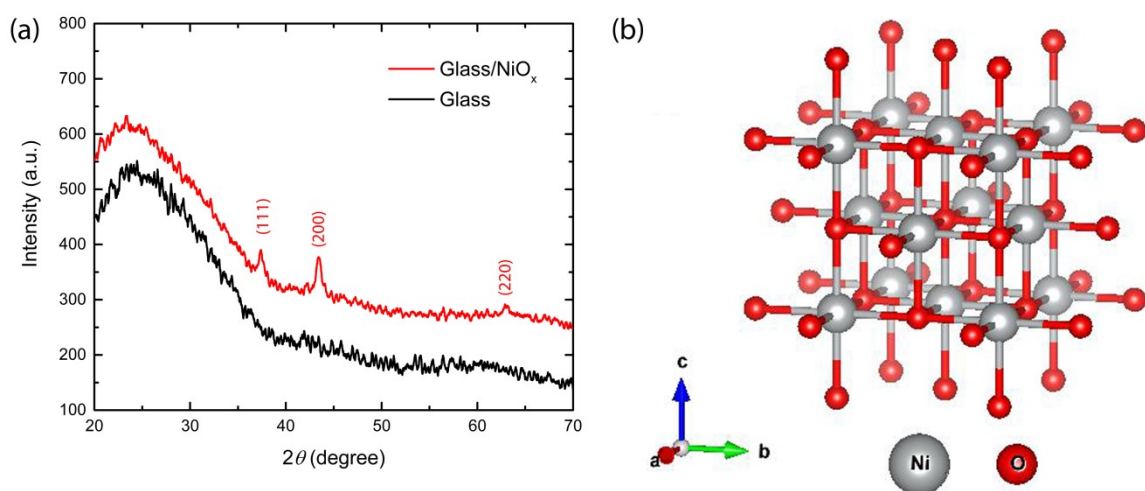


Figure S2. (a) XRD patterns of NiO_x thin films deposited on the glass substrate and (b) unit cell of NiO displaying face-centered cubic (FCC) structure.

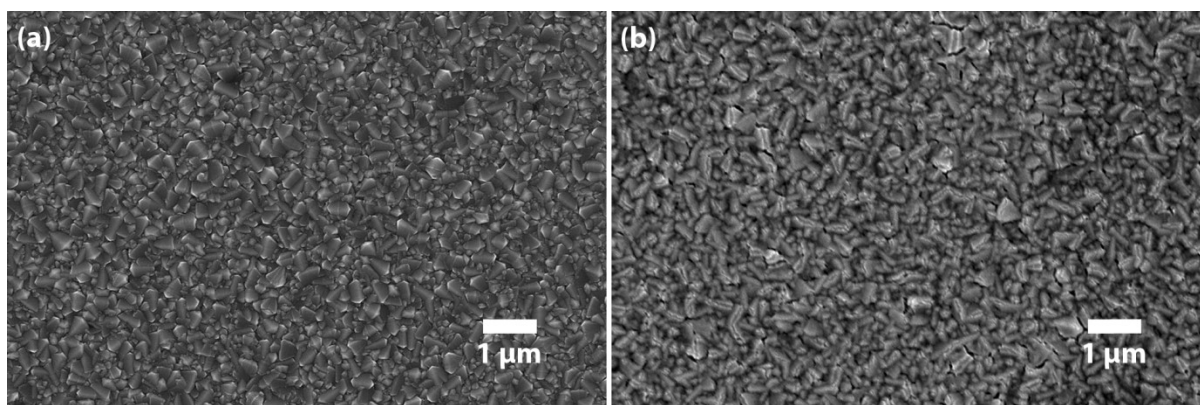


Figure S3. Top SEM images (a) bare FTO and (b) NiO_x

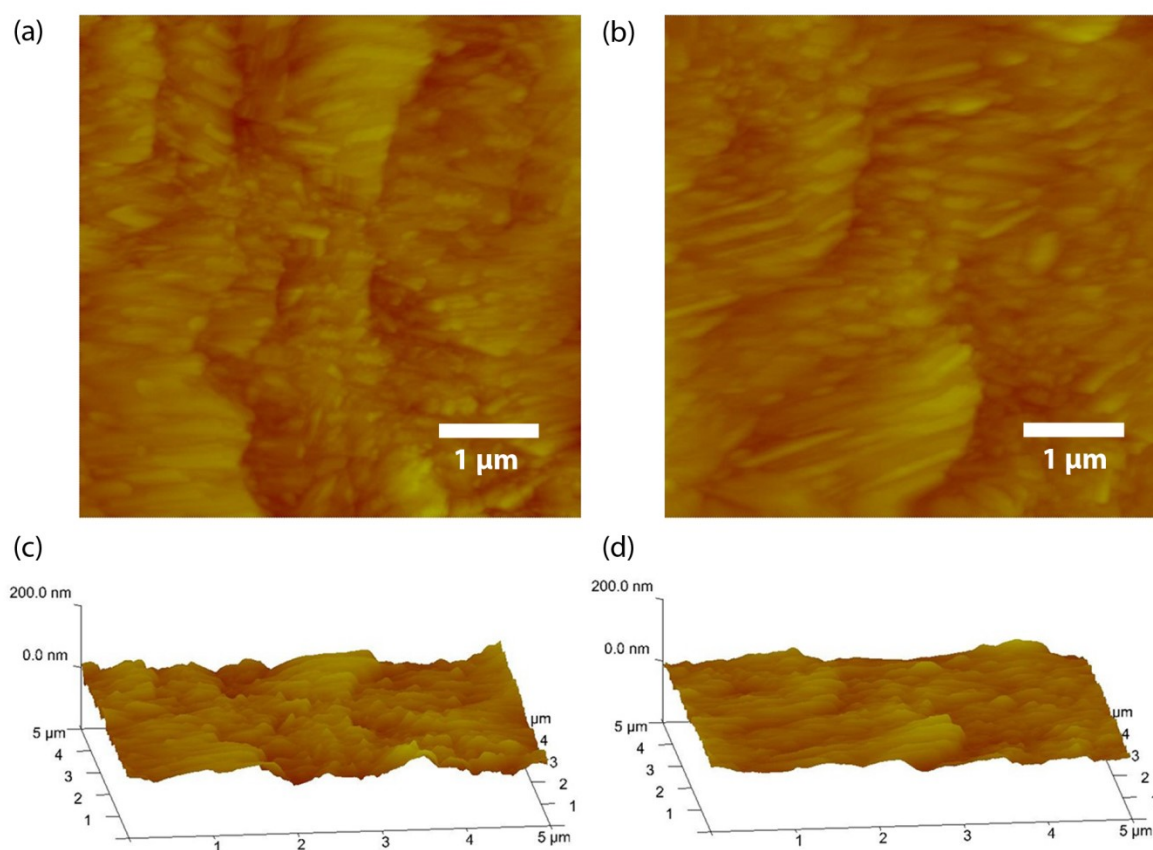


Figure S4. Top AFM images of: (a) bare FTO, (b) NiO_x deposited on FTO, (c) 3D AFM images bare FTO, and (d) 3D AFM image of NiO_x deposited on FTO.

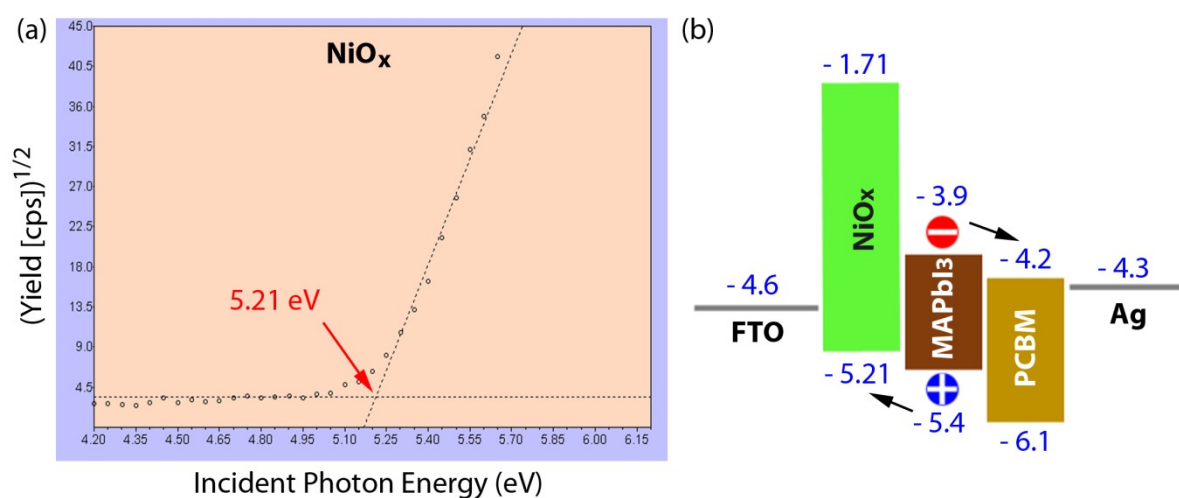


Figure S5. (a) Work function of NiO_x , (b) Energy levels of each layer used in inverted MAPbI_3 -based PSCs.

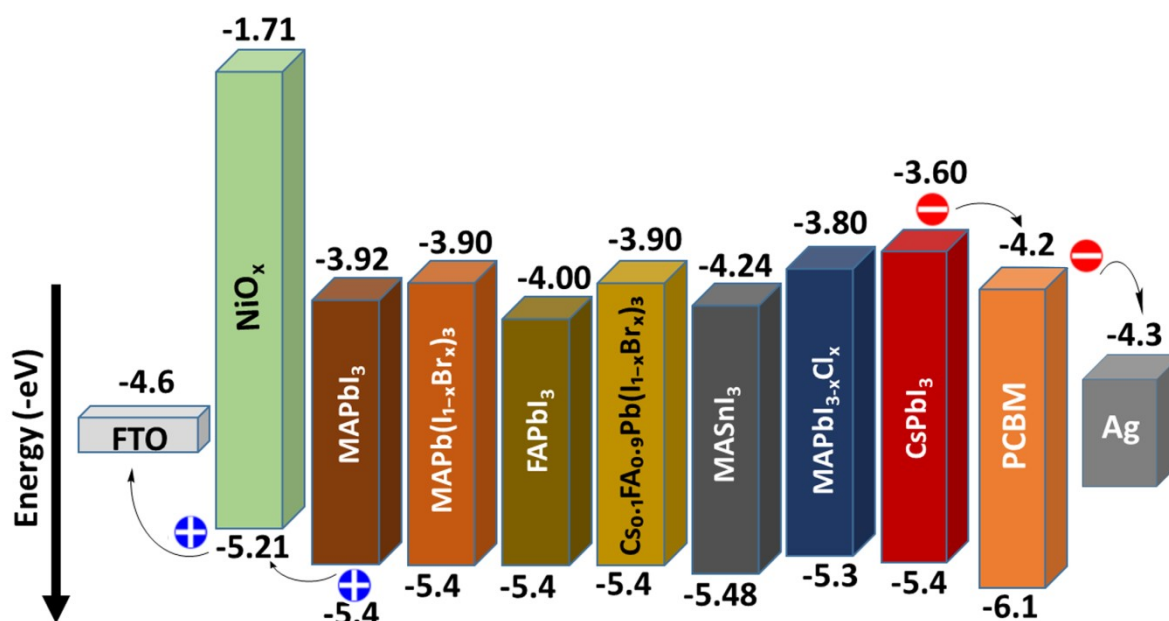


Figure S6. Energy-level diagram showing the valence band (VB) and conduction band (CB) positions of various common perovskites.

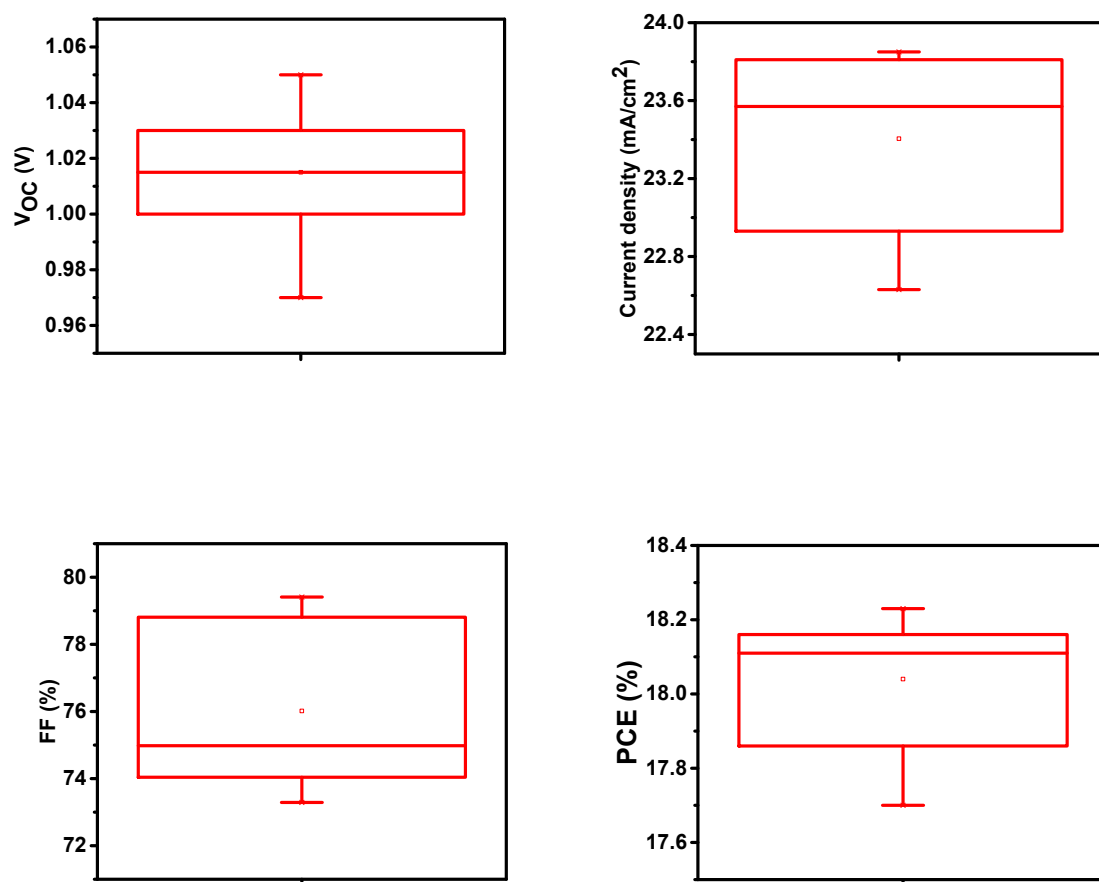


Figure S7. Statistical box plots of the PV parameters: (a) V_{OC} , (b) J_{SC} , (c) FF, and (d) PCE, obtained from MAPbI₃-based fresh devices using NiO_x as HTL.

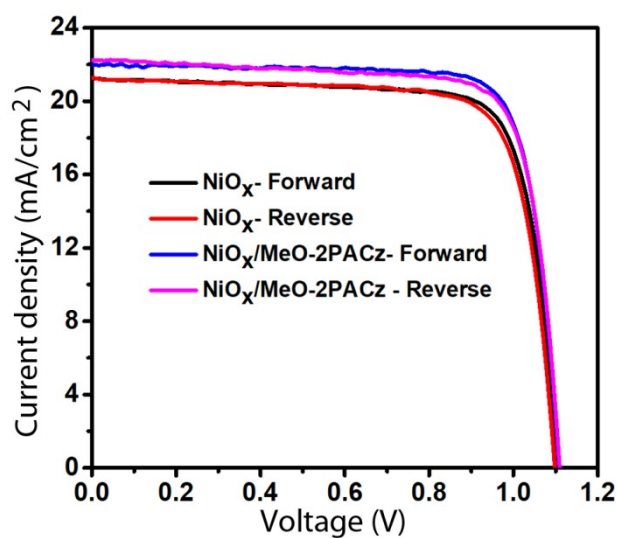


Figure S8. J - V of the champion CsFAMA-based perovskite solar cells.

Table S1. Photovoltaic performances of the NiO_x-based inverted perovskite solar cells. The statistics are based on 10 devices.

Device Structure	V_{OC} (V)	J_{SC} (mA/cm ²)	FF (%)	PCE (%)
FTO/NiO _x /MAPbI ₃ /PCBM/Ag	1.02 ± 0.03	23.40 ± 0.48	76.01 ± 2.52	18.04 ± 0.18
FTO/NiO _x /CsFAMAPbI ₃ /PCBM/Ag	1.06 ± 0.41	21.69 ± 0.60	78.05 ± 1.90	17.99 ± 0.22
FTO/NiO _x /MeO-2PACz/ CsFAMAPbI ₃ /PCBM/Ag	1.08 ± 0.34	22.37 ± 0.52	79.56 ± 1.36	19.13 ± 0.34