

Supporting information

Encapsulated MAPbBr₃ in nickel oxide nanotubes and their electroluminescence

Roberto Gonzalez-Rodriguez¹, Evan Hathaway¹, Yuankun Lin¹, Jeffery L. Coffey², and Jingbiao Cui^{1}*

1 Department of Physics, University of North Texas, Denton, Texas, 76203, USA

2 Department of Chemistry and Biochemistry, Texas Christian University, TCU Box 298860, Fort Worth, Texas, 76129, USA

* Corresponding author

E-mail: jingbiao.cui@unt.edu

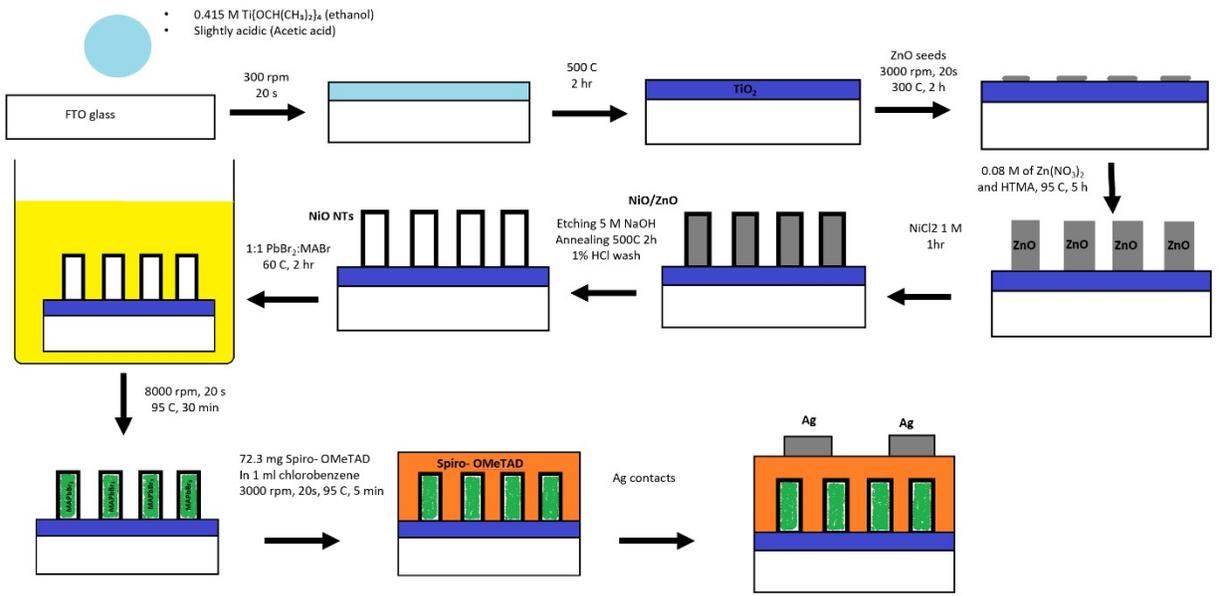


Figure S1. Fabrication procedures of MAPbBr₃/NiO₂ NT LED device.

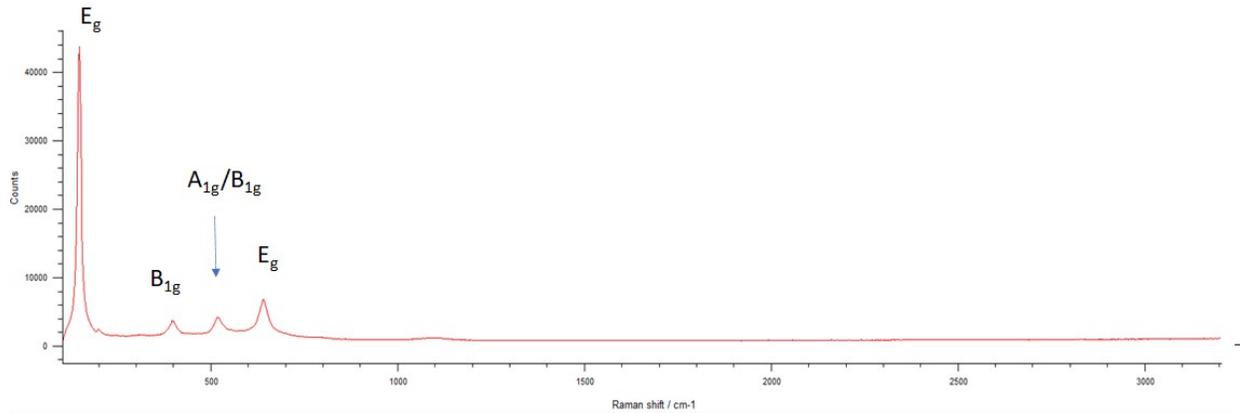


Figure S2. Raman spectrum of Anatase phase TiO₂ layer on FTO glass.

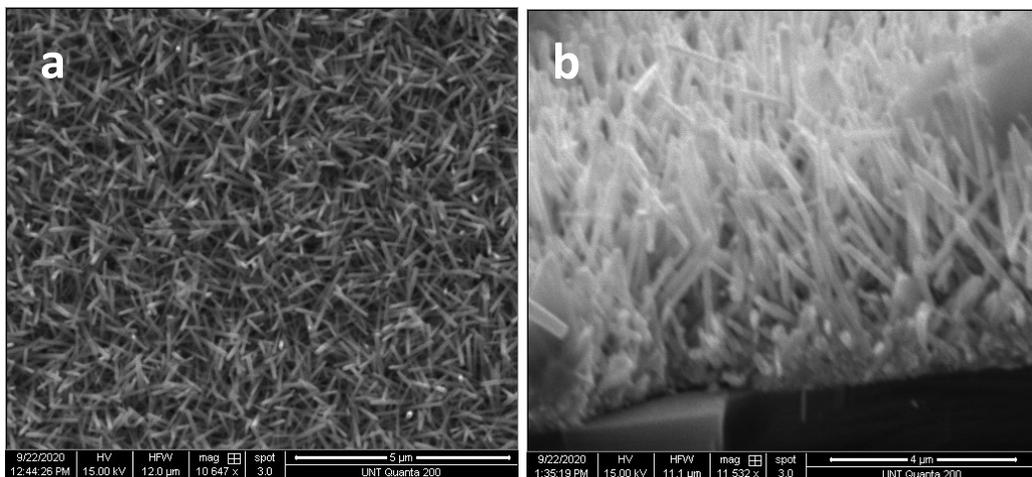


Figure S3. SEM of ZnO NWs array: a). top view and b). cross section view with 30° tilt.

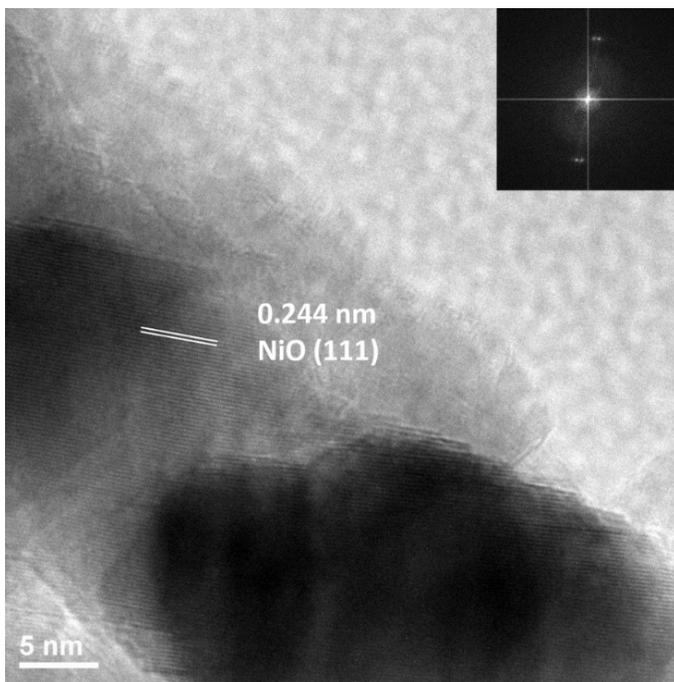


Figure S4. HRTEM image of pNiO nanotube with the corresponding FFT in the inset.

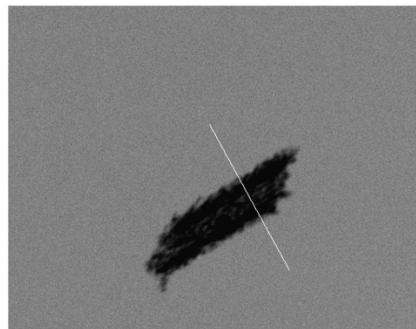
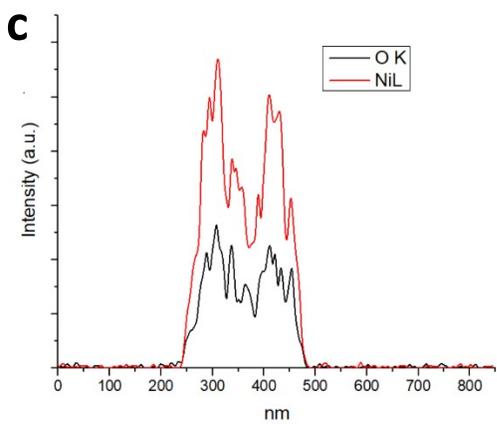
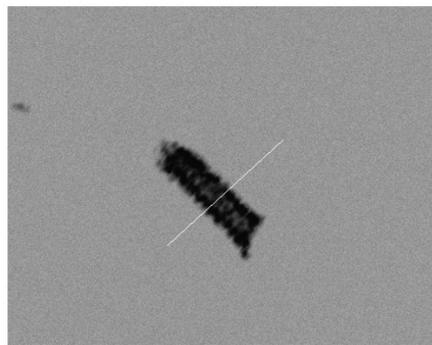
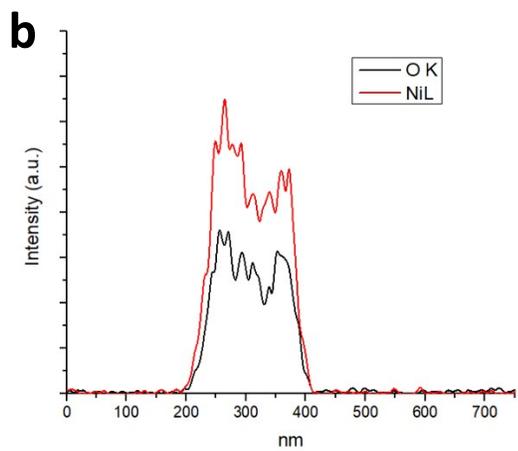
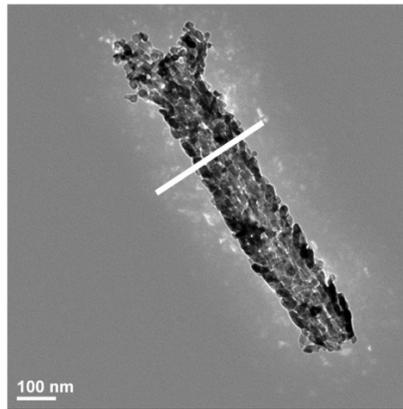
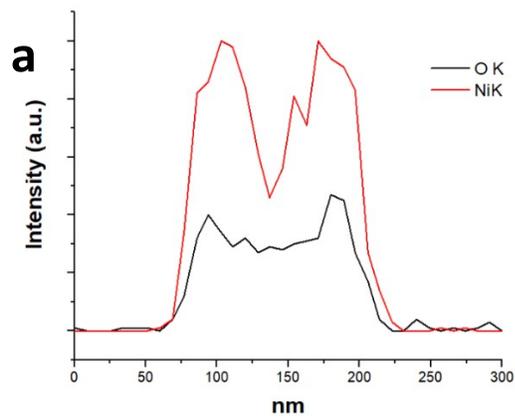


Figure S5. Line scans and TEM images of pNiO NTs with nickel deposition for: a) 1 h, b) 2 h, and c) 3 h.

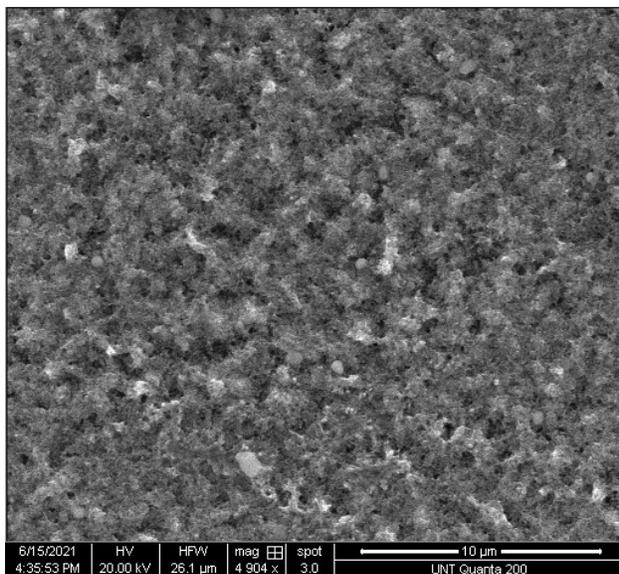


Figure S6. SEM image of MAPbBr₃ inside NiO NTs with NiO deposition for 30 min.

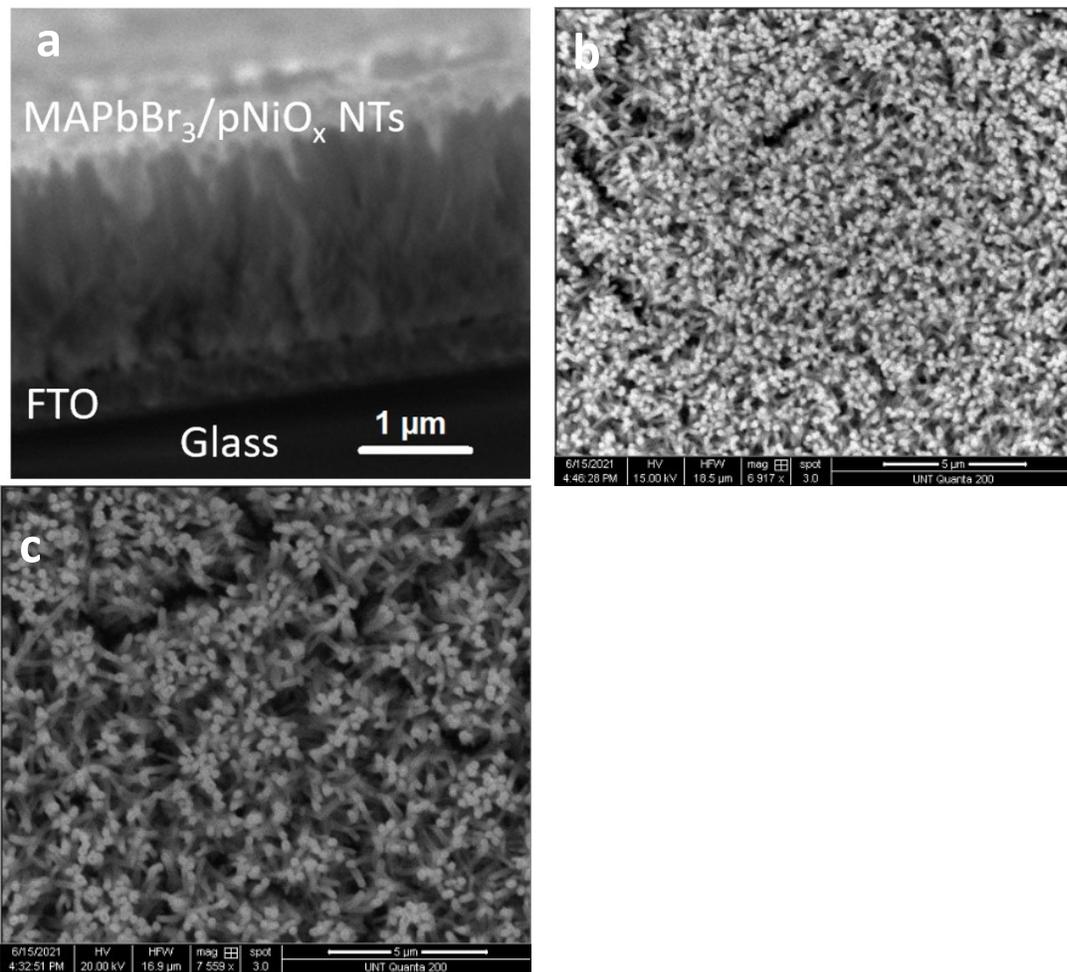


Figure S7. SEM images of MAPbBr₃ inside pNiO NTs with NiO deposition for a) 1 h (cross-section SEM), b) 2 h and b) 3 h.

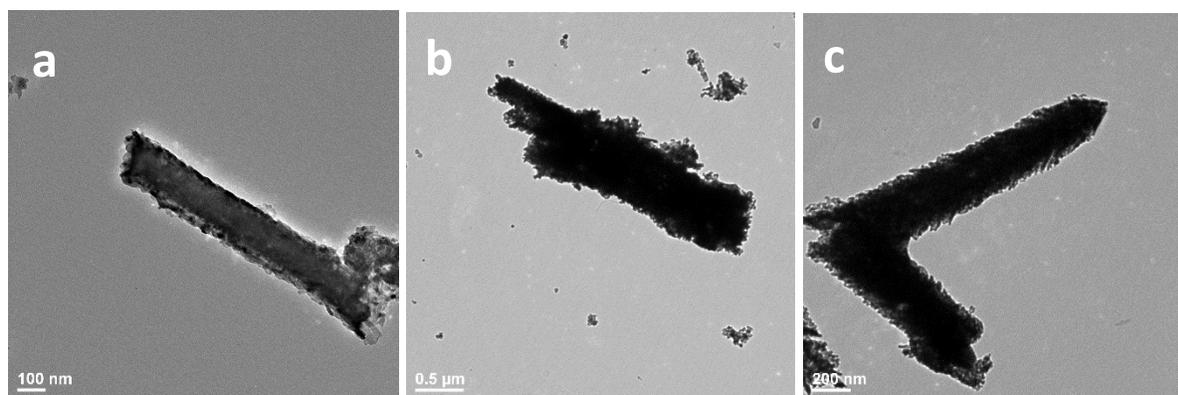


Figure S8. TEM images of MAPbBr₃ inside pNiO NTs with NiO deposition for a) 1 h, b) 2 h, and c) 3 h.

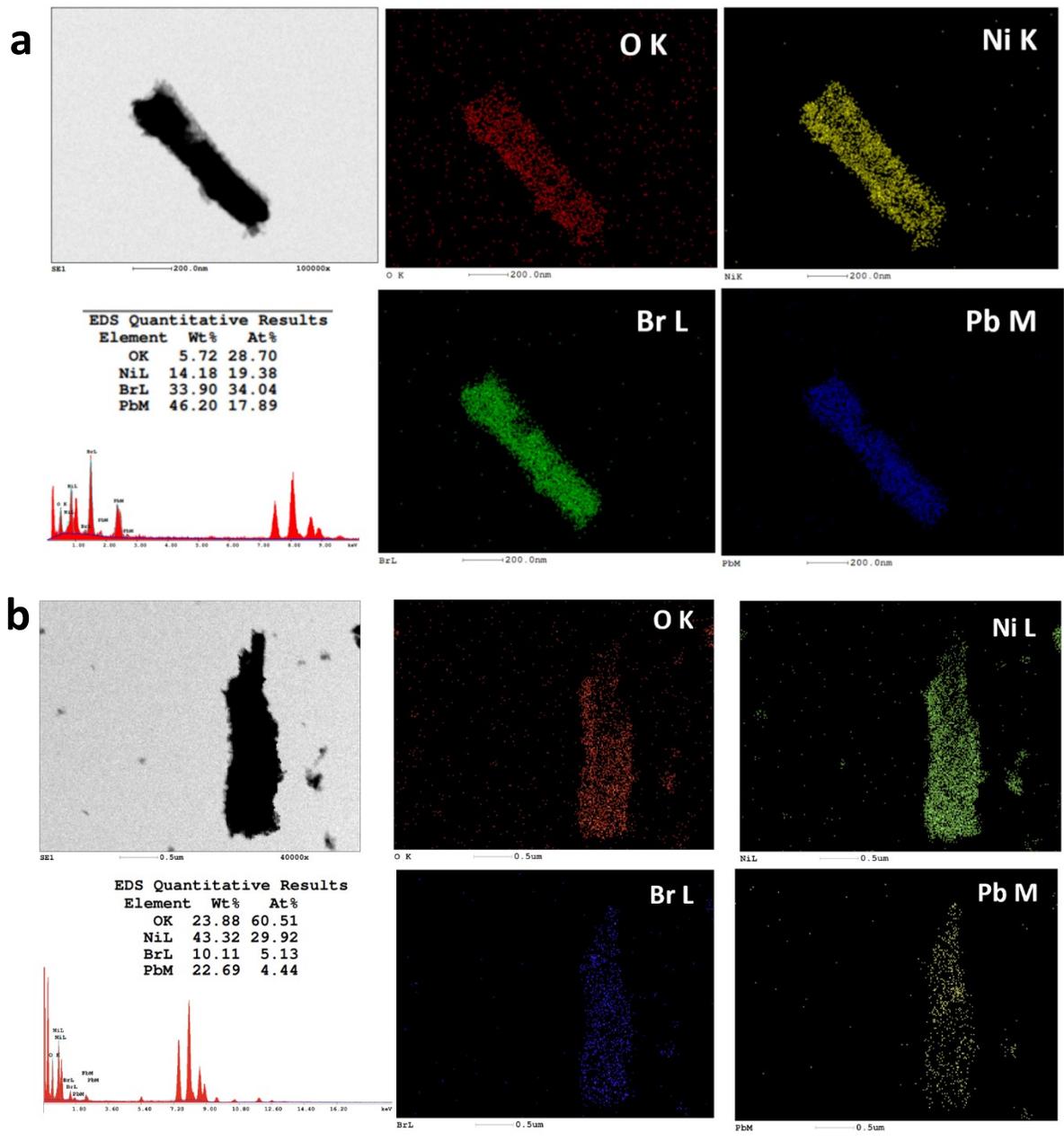


Figure S9. TEM-EDX maps of MAPbBr₃ inside pNiO NTs with NiO deposition for a) 1 h and b) 2 h.

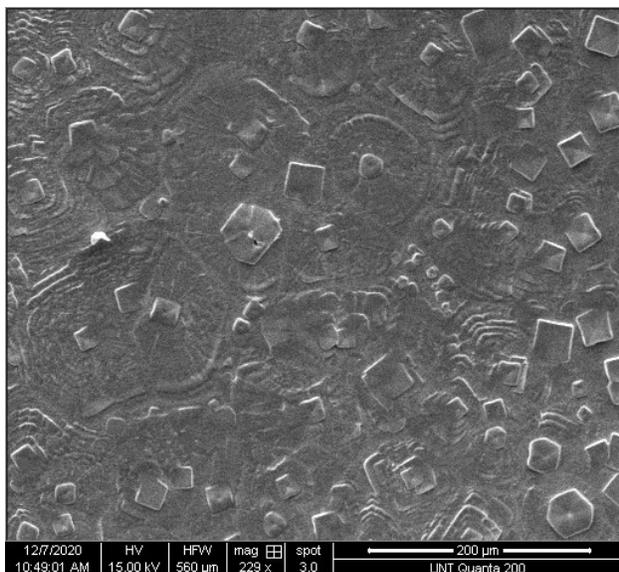


Figure S10. SEM image of bulk MAPbBr₃.

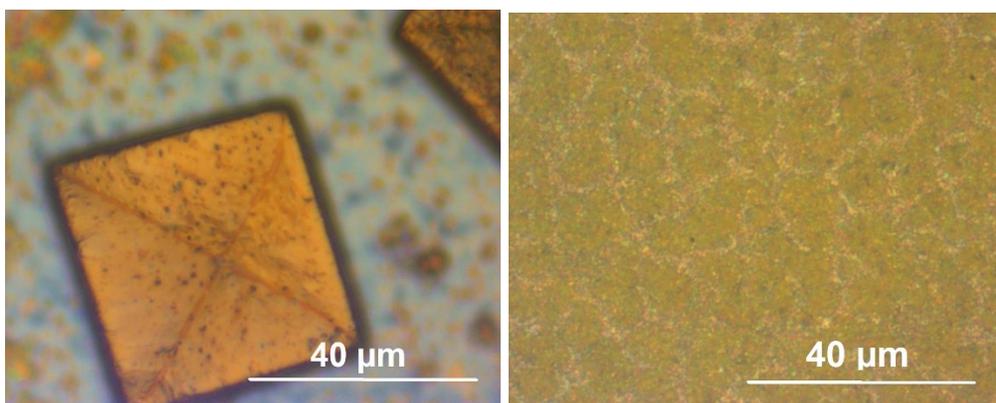


Figure S11. Optical images of a) bulk MAPbBr₃ and b) MAPbBr₃ inside pNiOx NTs.

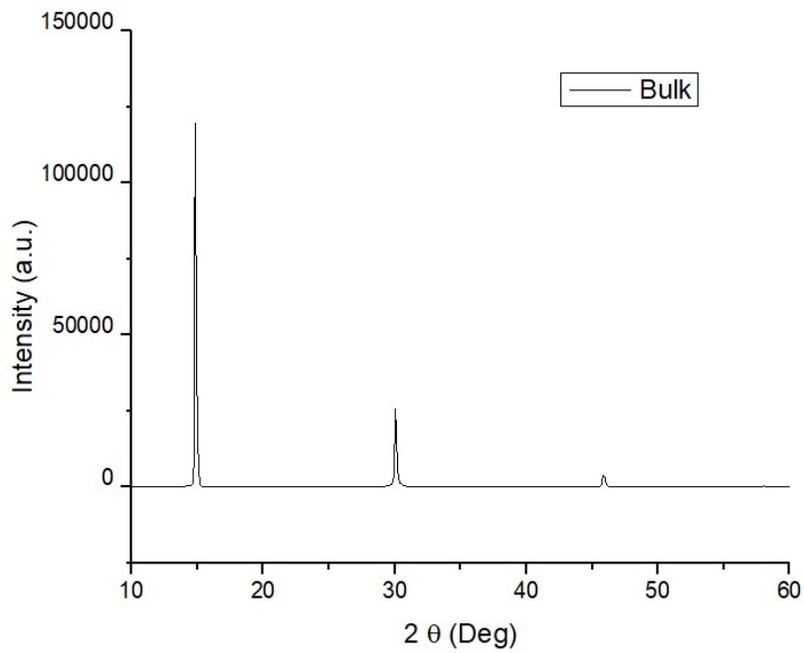
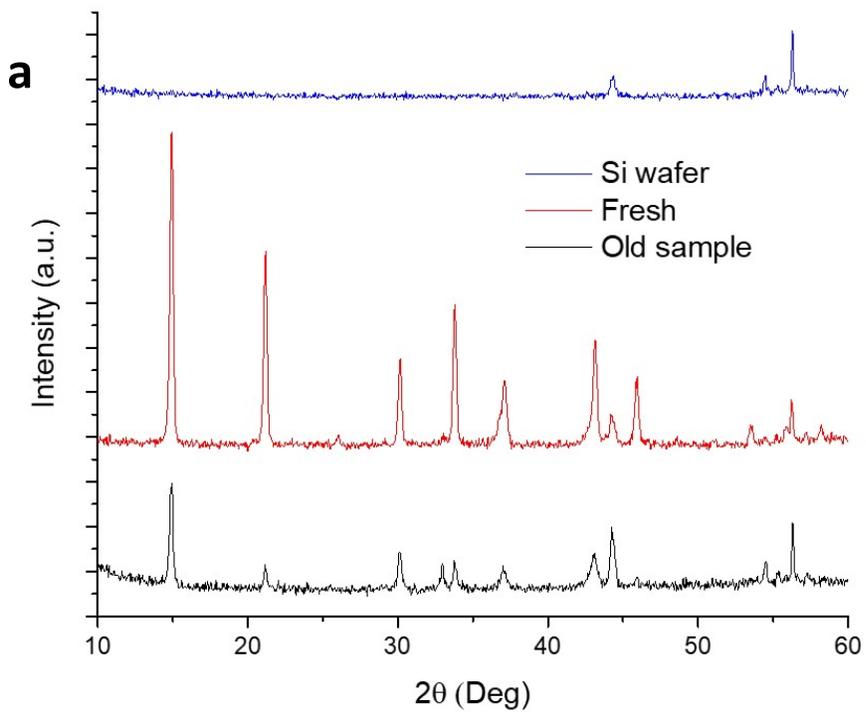


Figure S12. XRD pattern of bulk MAPbBr₃.



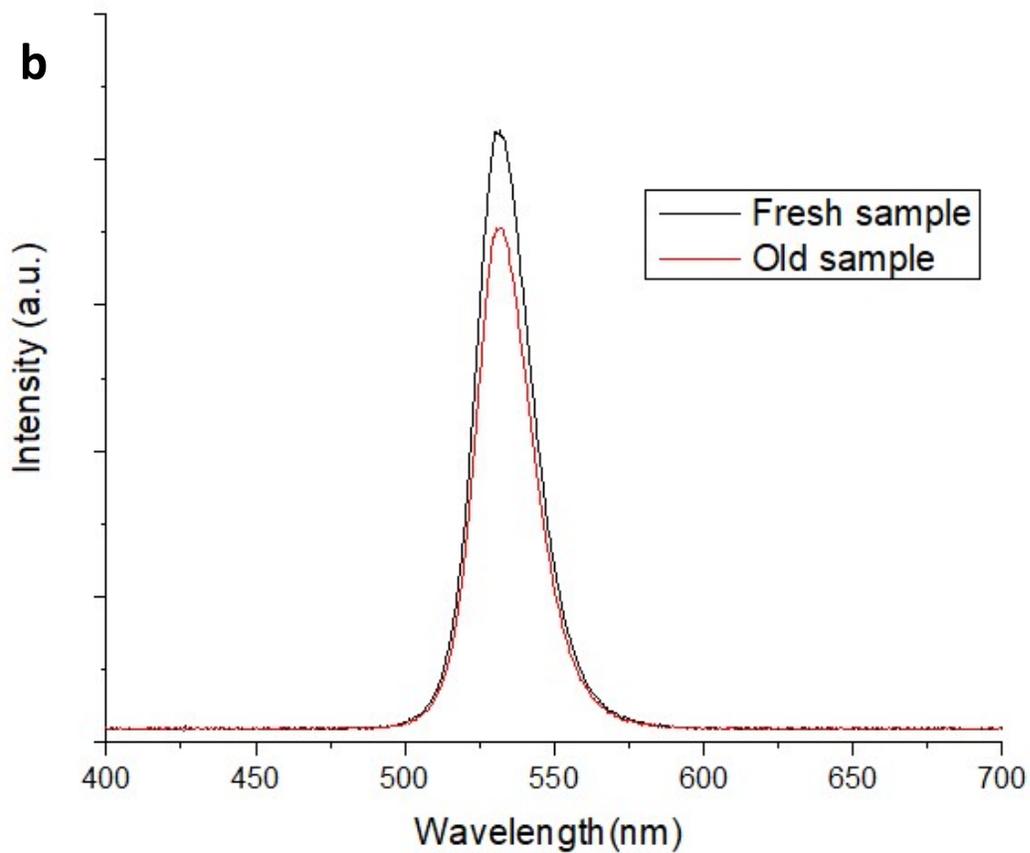


Figure S13. a) XRD patterns of fresh and 3 months old MAPbBr₃ inside pNiOx NTs on silicon wafer. The pattern from Si wafer is also shown for reference and b) PL of fresh and 3 months MAPbBr₃ inside pNiOx NTs on silicon wafer.

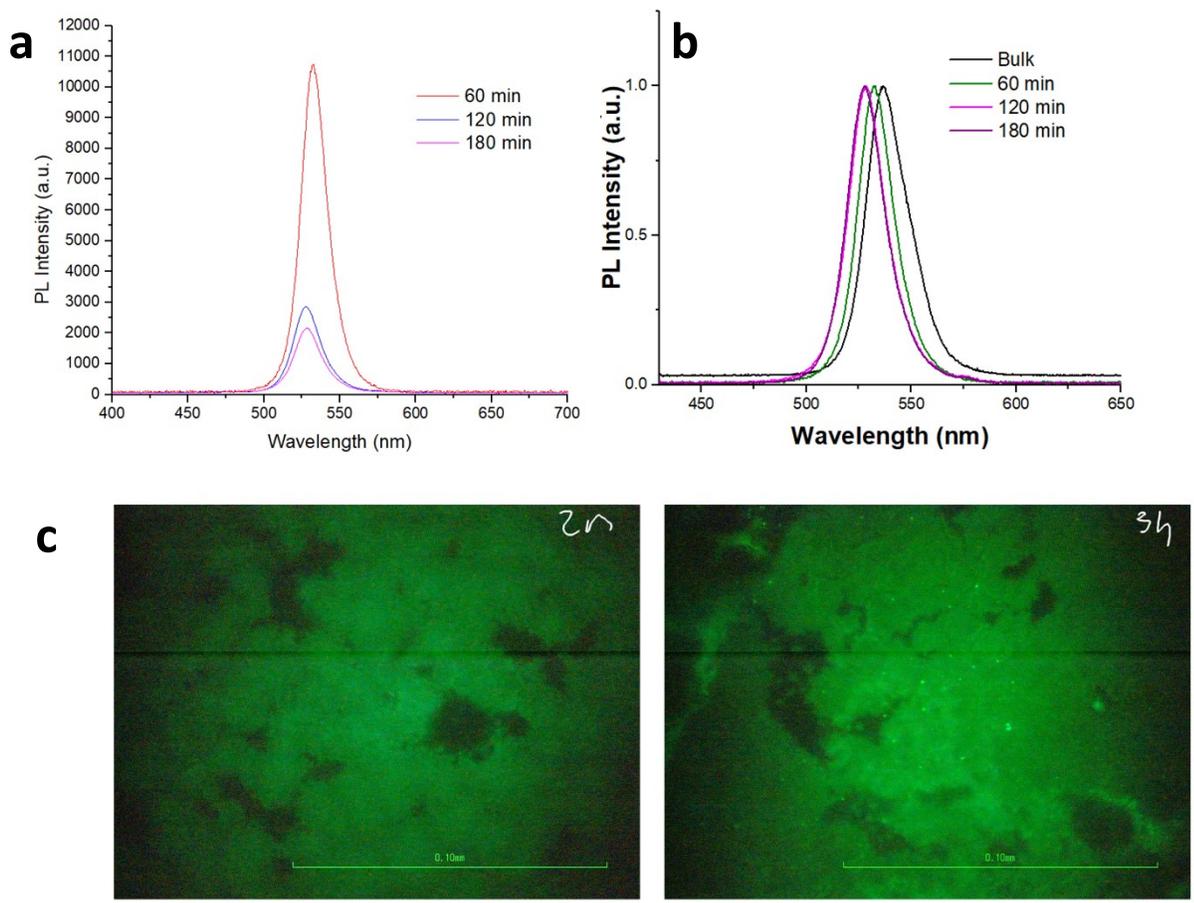


Figure S14. a) PL spectra of MAPbBr₃ inside pNiOx NTs, b) Normalized PL spectra and the comparison with MAPbBr₃ bulk and c) PL image of MAPbBr₃ inside NiO NTs with NiO deposition for 2 and 3 h.

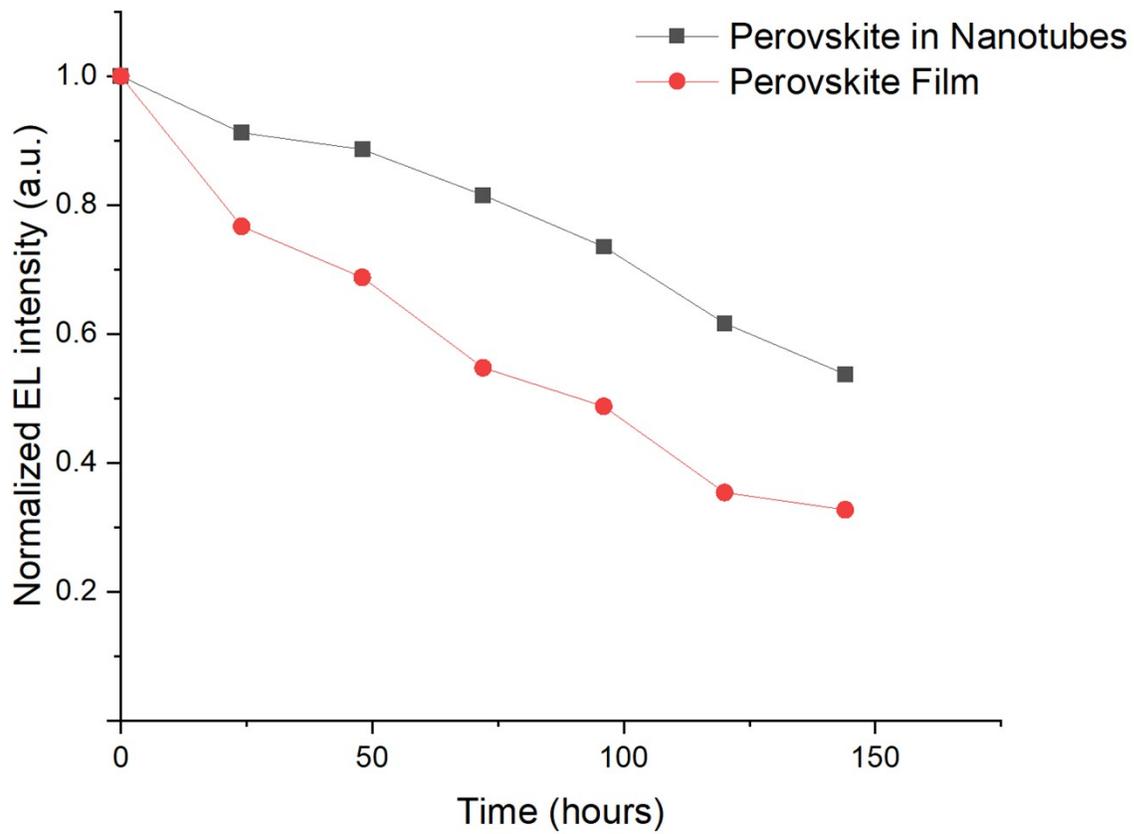


Figure S15. Comparison of LED stability from perovskite in NiO nanotubes and the film only.