

Supplementary Information

Morphology-Driven Oxygen Evolution Performance of NiO_x Nanostructures and Implications for Hole Transport in Perovskite Solar Cells

Prabhu Bharathan,^a Can Li,^b Bipin Rijal,^c Lihua Zhang,^d Areesha Maryam,^b Joseph Delgado,^b Kim Kisslinger,^d Adyasa Priyadarsini,^e Mahesh Nepal,^c Tanka P. Bhushal,^c Tara P. Dhakal,^{*a,c} Shyam Kattel^{*f} and Jiye Fang^{*a,b}

^aMaterials Science and Engineering Program, State University of New York at Binghamton, Binghamton, New York 13902, United States.

^bDepartment of Chemistry, State University of New York at Binghamton, Binghamton, New York 13902, United States.

^cDepartment of Electrical and Computer Engineering, Center for Autonomous Solar Power (CASP), Binghamton University, Binghamton, New York 13902, United States.

^dCenter for Functional Nanomaterials, Brookhaven National Laboratory, Upton, New York 11973, United States.

^eDepartment of Physics, Florida A&M University, Tallahassee, Florida 32307, United States.

^fDepartment of Physics, University of Central Florida, Orlando, Florida 32816, United States.

* Corresponding Authors.

e-mail addresses:

tdhakal@binghamton.edu (T. P. Dhakal);

shyam.kattel@ucf.edu (S. Kattel);

jfang@binghamton.edu (J. Fang).

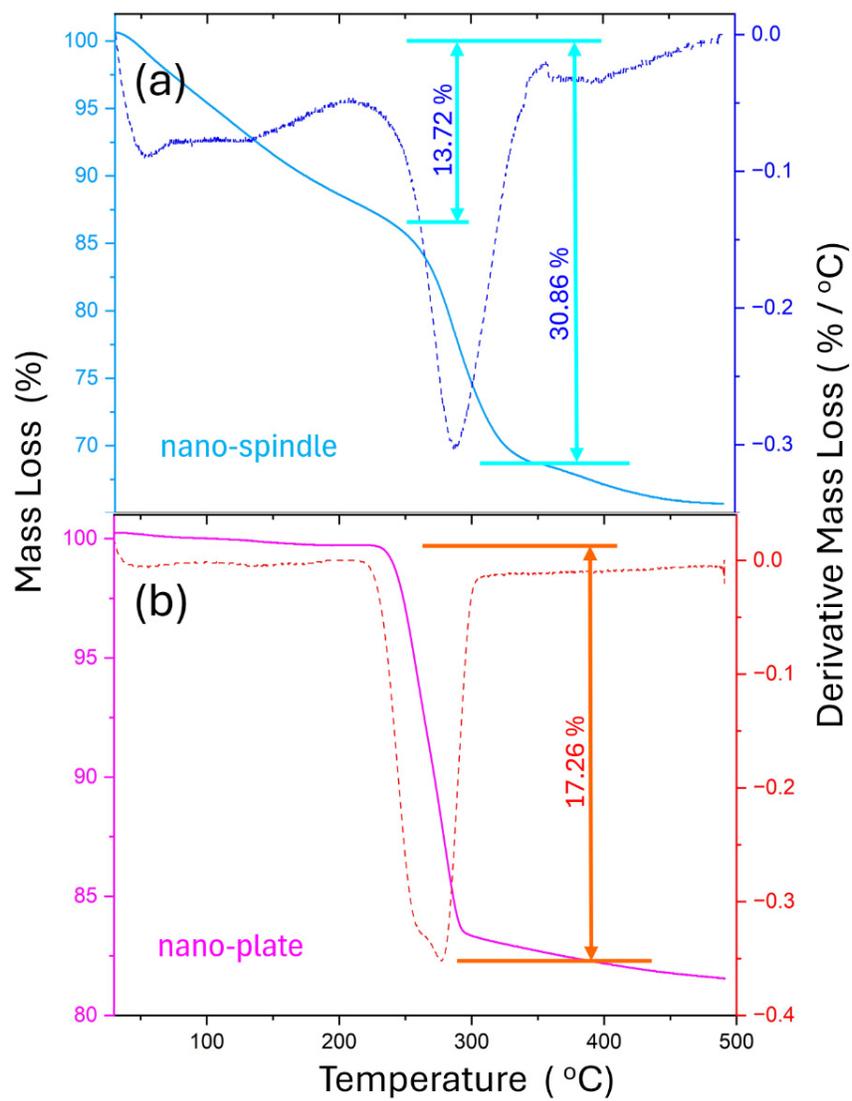


Fig. S1. Thermogravimetric analysis (TGA) and derivative thermogravimetry (DTG) plots, showing the thermal transformation of hydroxide-based (a) nano-spindles and (b) nano-plates, synthesized *via* Route (A) and Route (B), respectively.

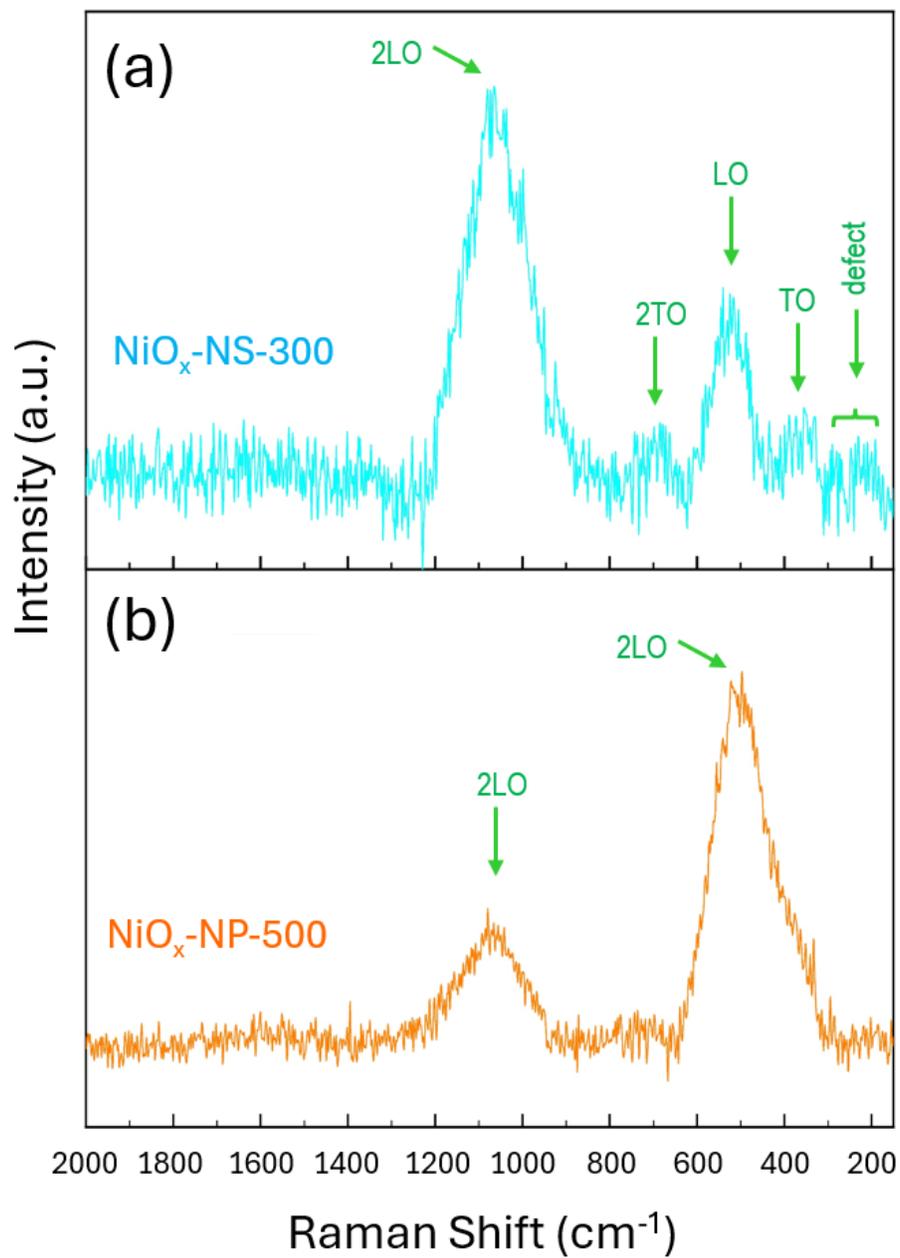


Fig. S2. Room temperature Raman spectra ($\lambda_{\text{ex}} = 532 \text{ nm}$) of pristine NiO_x -NS-300 and NiO_x -NP-500.

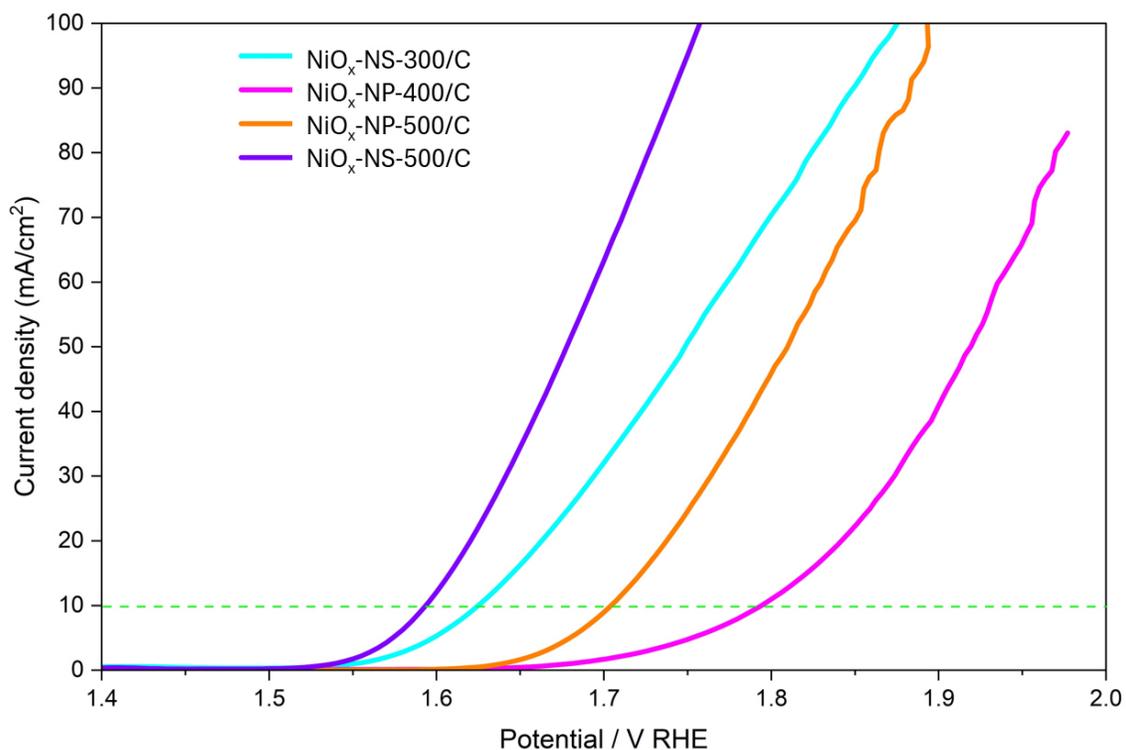


Fig. S3. Polarization curves (current density vs. potential) recorded in 1 M KOH at an electrode rotation speed of 1600 rpm. At benchmark current density of 10 mA/cm² (shown as the horizontal dashed line), OER overpotentials for NiO_x-NS-300/C, NiO_x-NP-400/C, NiO_x-NS-500/C, and NiO_x-NP-500/C are 395, 565, 364, and 474 mV, respectively.

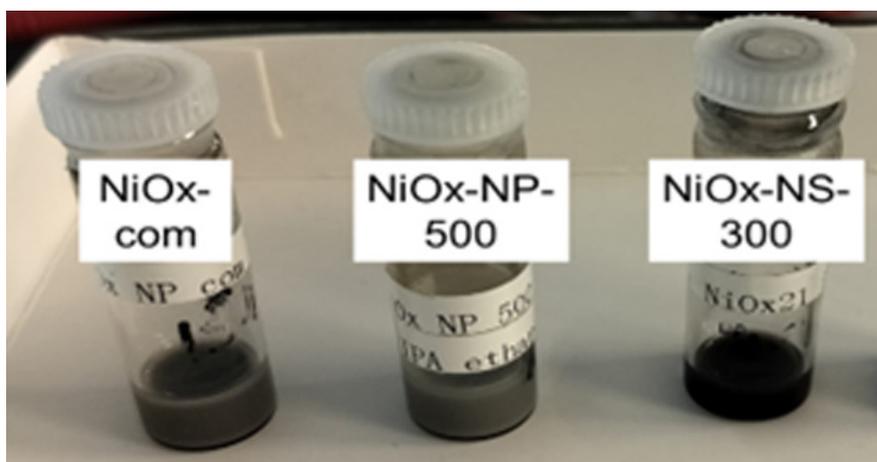


Fig. S4. Photographs of inks prepared from NiO_x-com (commercial sample), NiO_x-NP-500, and NiO_x-NS-300, showing distinct color differences.