# SUPPORTING INFORMATION

# Energy Levels, Electronic Properties, and Rectification in Ultrathin P-NiO films Synthesized by Atomic Layer Deposition

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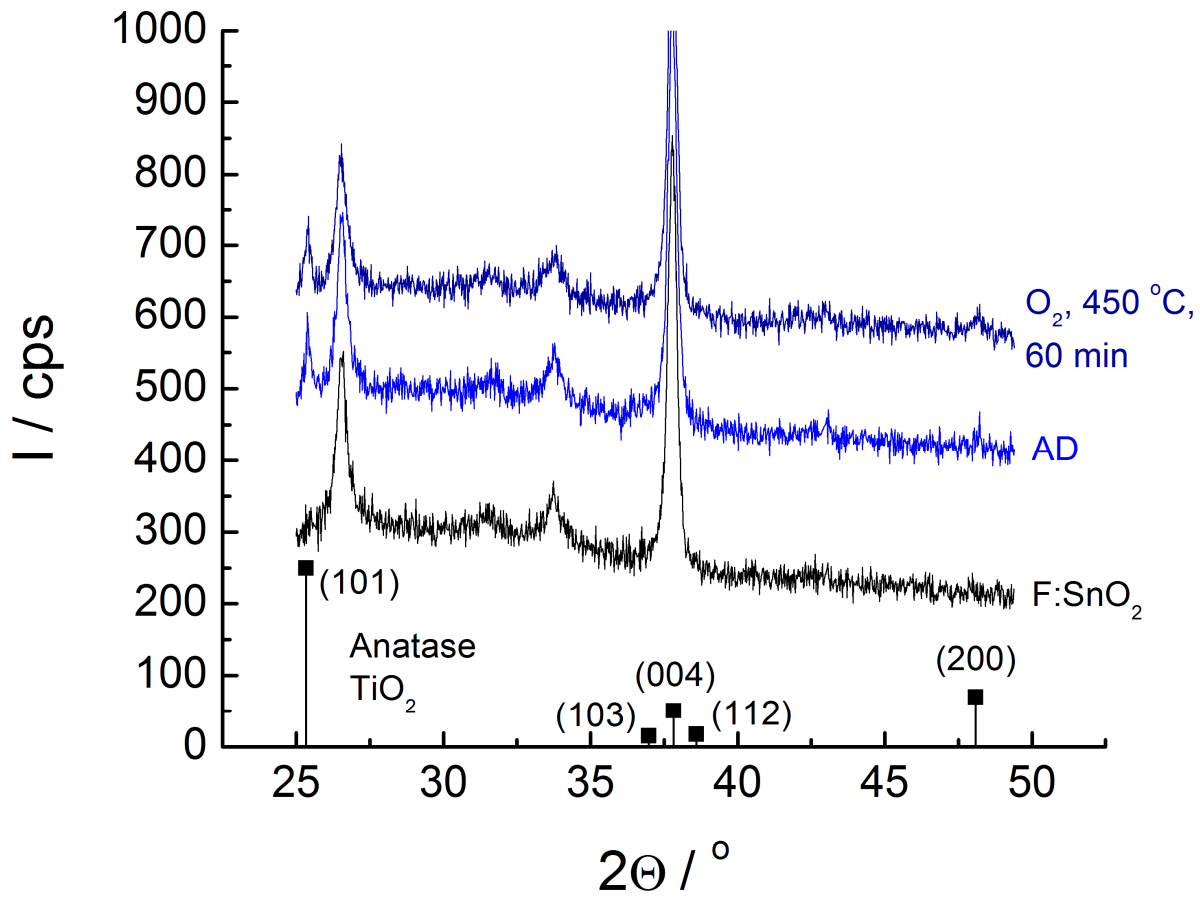


**Figure S1:** XRD patterns for the as-deposited 72 nm $TiO_2$ films on an FTO substrate. The black curve is a blank substrate, the light blue curve is the $TiO_2$ as-deposited at 225 $^{o}$C (AD), and the dark blue curve is after annealing at 450 $^{o}$C for 60 minutes in $O_2$. The XRD pattern for anatase $TiO_2$ is given at the bottom.

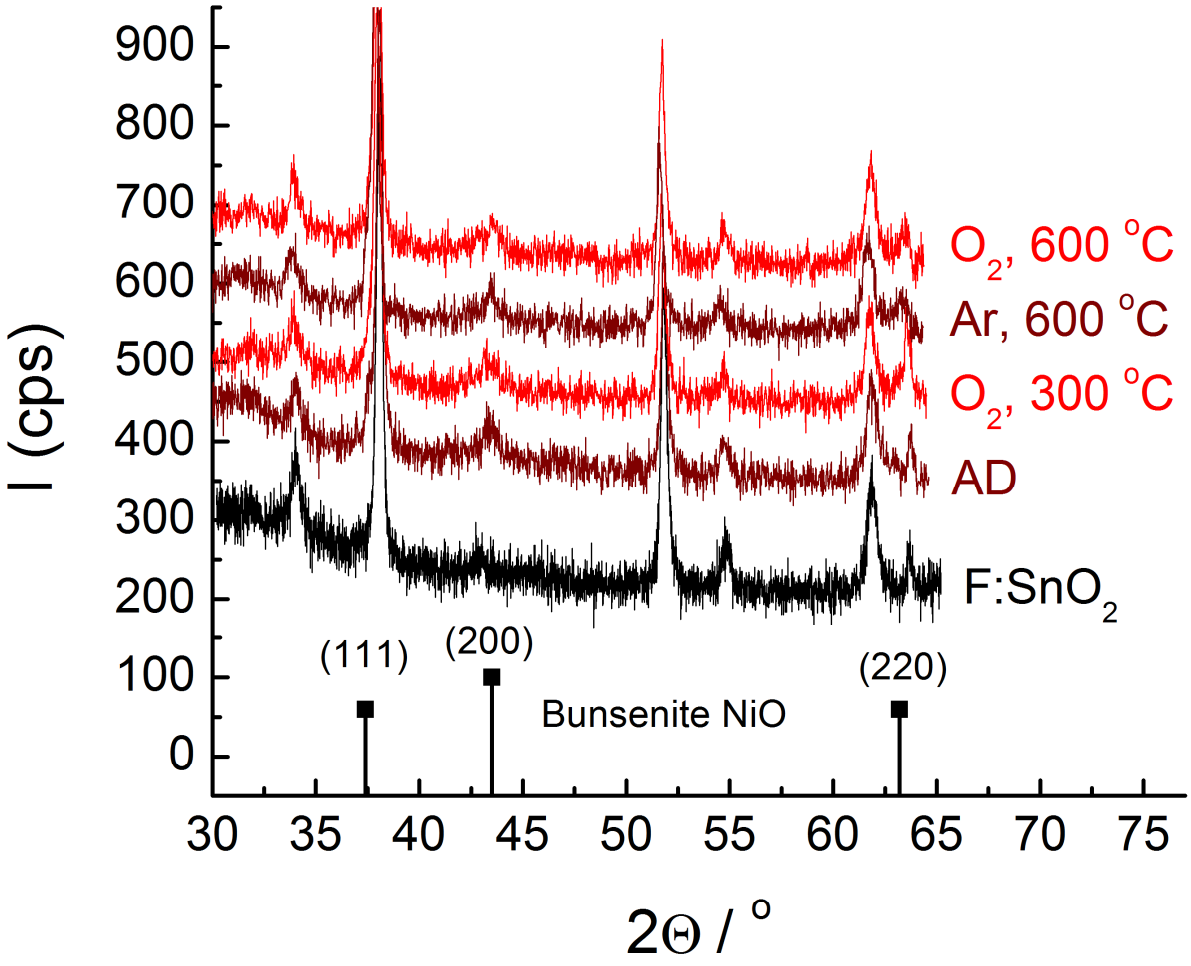


**Figure S2:** XRD pattern for bunsenite NiO (lines at bottom), FTO substrate (black) and 71 nm NiO films annealed at various conditions. AD = as-deposited. The annealing gas and temperature are indicated next to each spectra. The duration of annealing was 30 minutes for the films of the top three spectra.

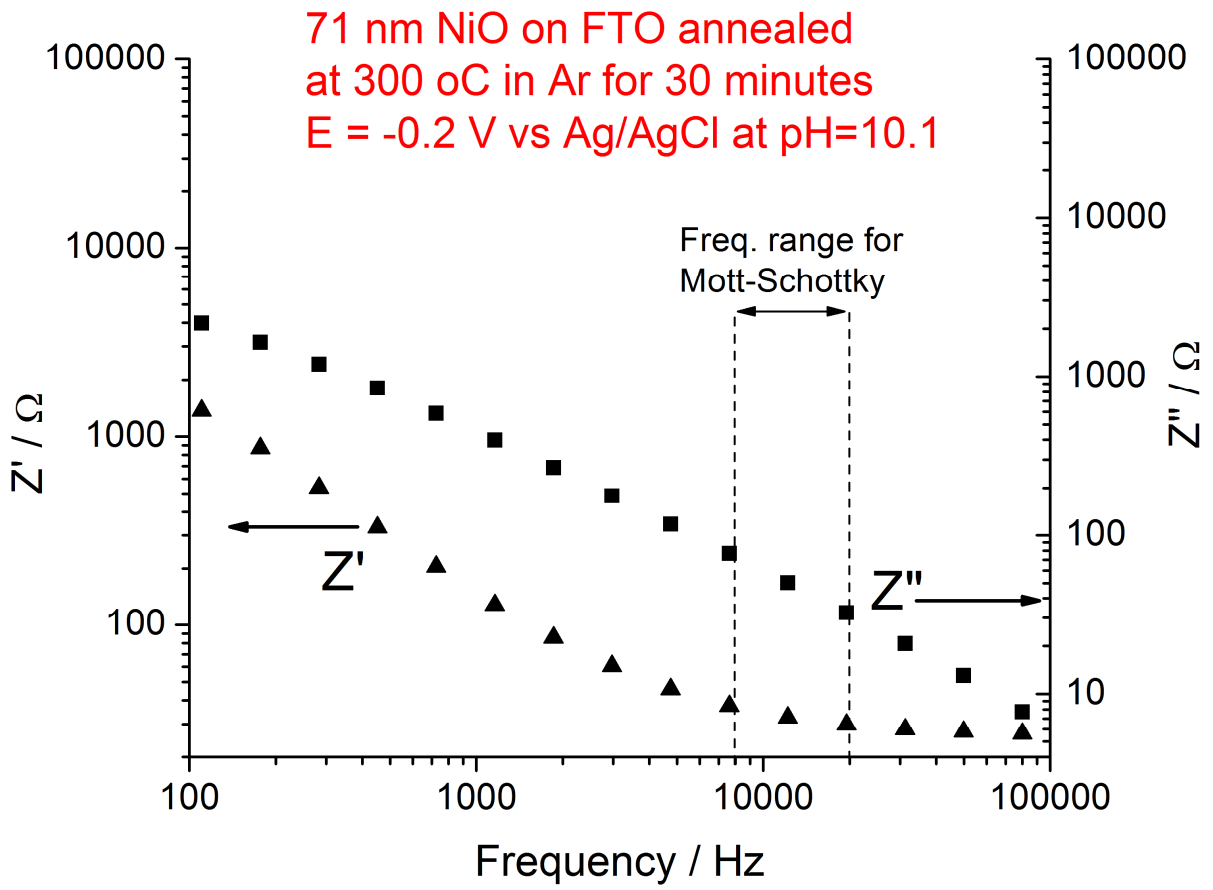


**Figure S3:** A representative electrochemical Bode plot of the real (Z') and imaginary (Z") components of the impedance. At 8 kHz and higher frequencies the equivalent circuit can be accurately modeled by a resistor in series with a capacitor, as indicated by the relatively constant real component. The indicated frequency range was used for Mott-Schottky analysis.

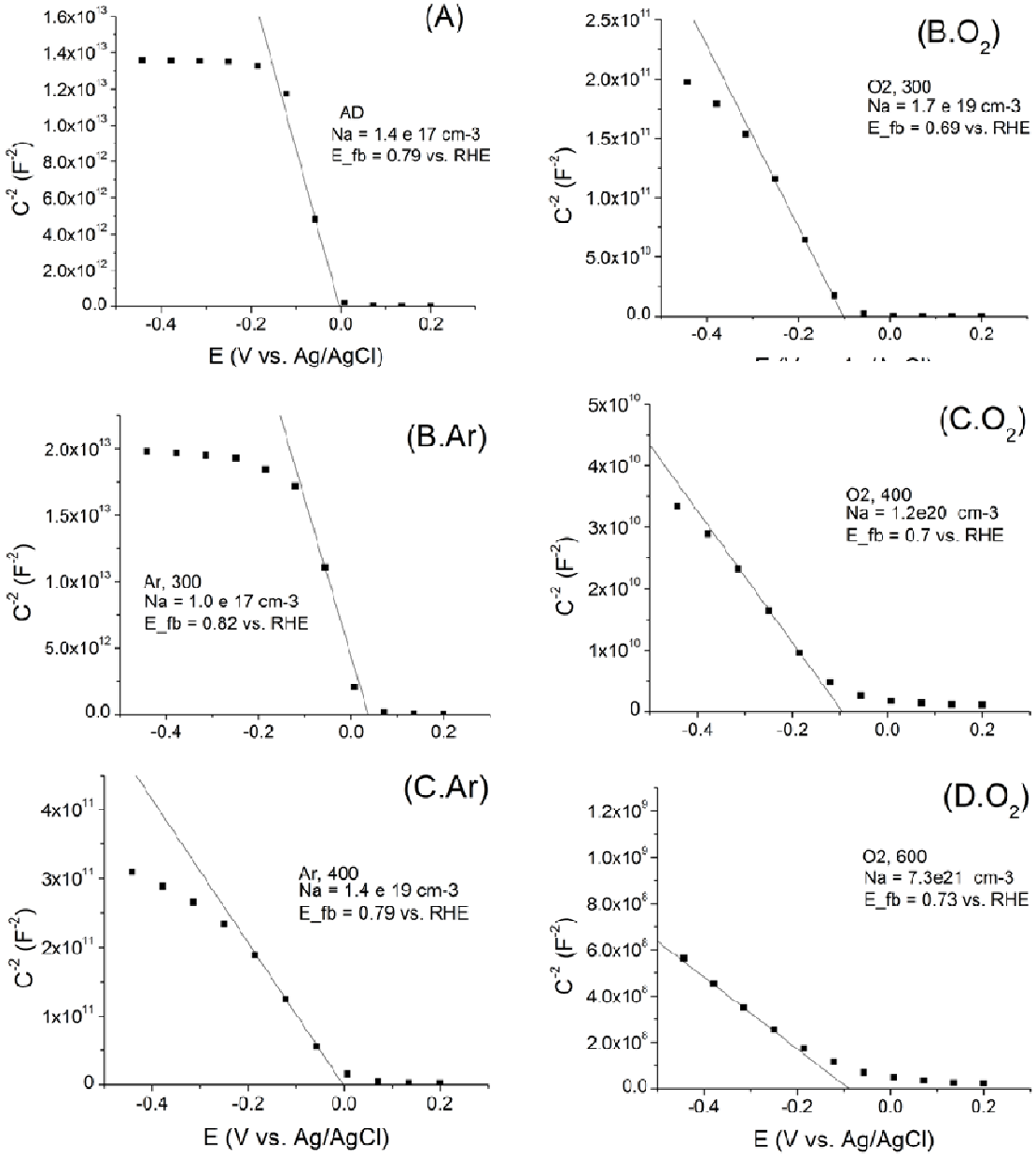


**Figure S4**: Mott-Schottky plots at 14.7 kHz for 71 nm NiO films on FTO annealed at different temperatures using different atmospheres for a duration of 30 minutes. The area wetted by the electrolyte was 1 $cm^2$. The conditions were: A) as-deposited, B.Ar) 300 $^oC$ in Ar, C.Ar) 400 $^oC$ in Ar, B.$O_2$) 300 $^oC$ in $O_2$, C.$O_2$) 400 $^oC$ in $O_2$ and D.$O_2$) 600 $^oC$ in $O_2$.

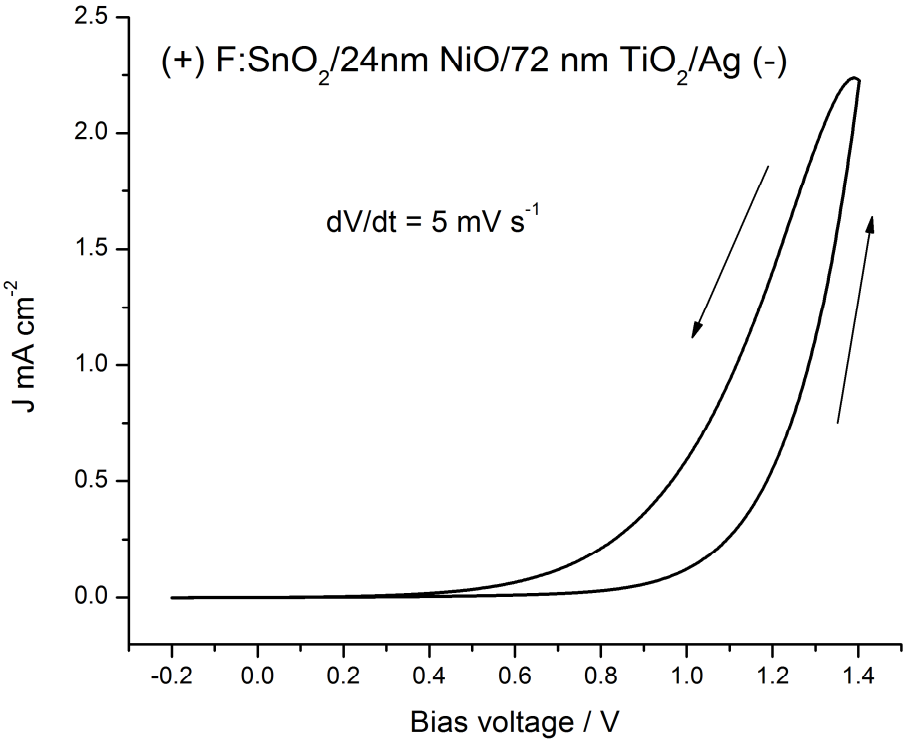


**Figure S5:** Solid state cyclic voltamagram for the $NiO/TiO_2$ diode. The layer thicknesses and lead polarities are indicated at the top. The scan rate was 5 mV $s^{-1}$.

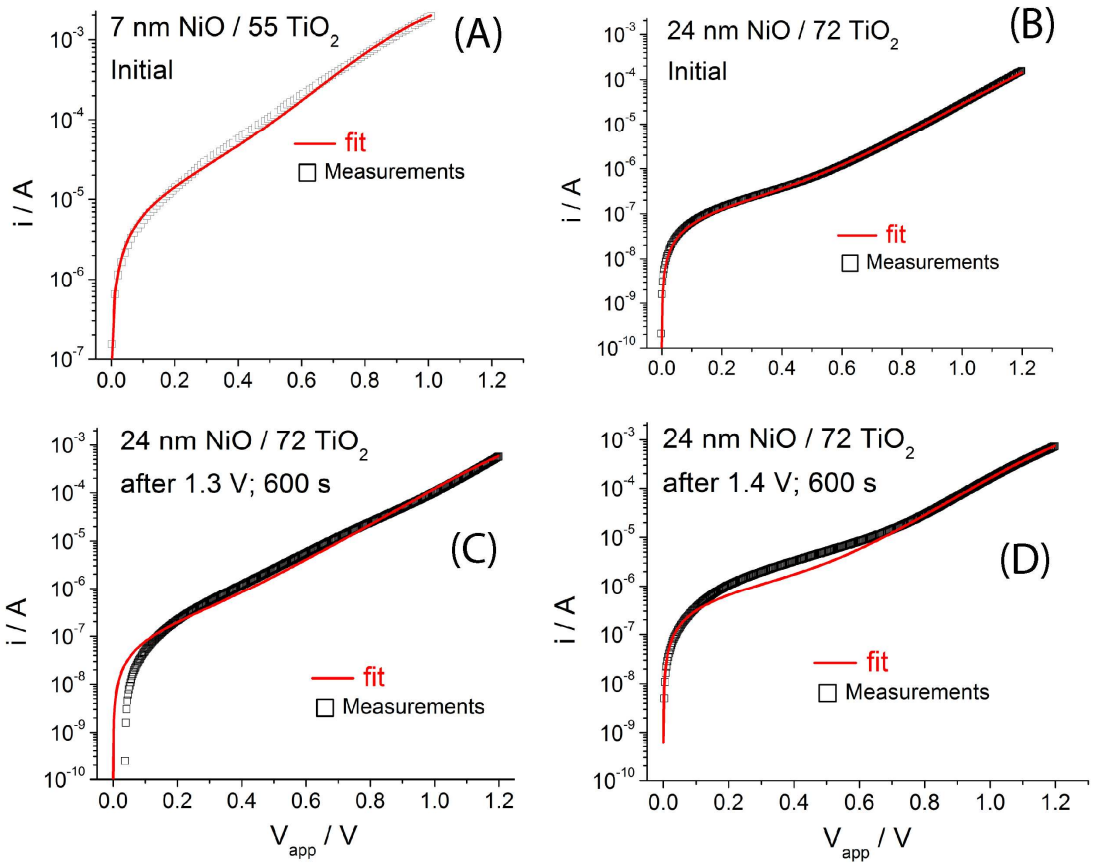


**Figure S6:** IV curves for diodes with the structure FTO/NiO/$TiO_2$/100 nm Ag of different layer thicknesses, initially and after measurement of current at the indicated voltage for a period of 600 seconds. (A) thinner layers, initial IV curve; (B) thicker layers, initial IV curve; (C) thicker layers immediately after current measurement at a constant voltage of 1.3 V; (D) thicker layers immediately after current measurement at a constant voltage of 1.4 V.