Supplementary Information for:

Air-Processed Inverted Organic Solar Cells Utilizing a 2-Aminoethanol-Stabilized ZnO Nanoparticle Electron Transport Layer That Requires No Thermal Annealing

Il Jeon,[a] James W. Ryan[a], Tafu Nakazaki[b], Kee Sheng Yeo[a], Yuichi Negishi[b] and Yutaka Matsuo[a]*

[a] Department of Chemistry, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan
[b] Department of Applied Chemistry, Tokyo University of Science, 1-3 Kagurazaka, Shinjuku, Tokyo 162-8601, Japan

S1. Transition Electron Microscopy

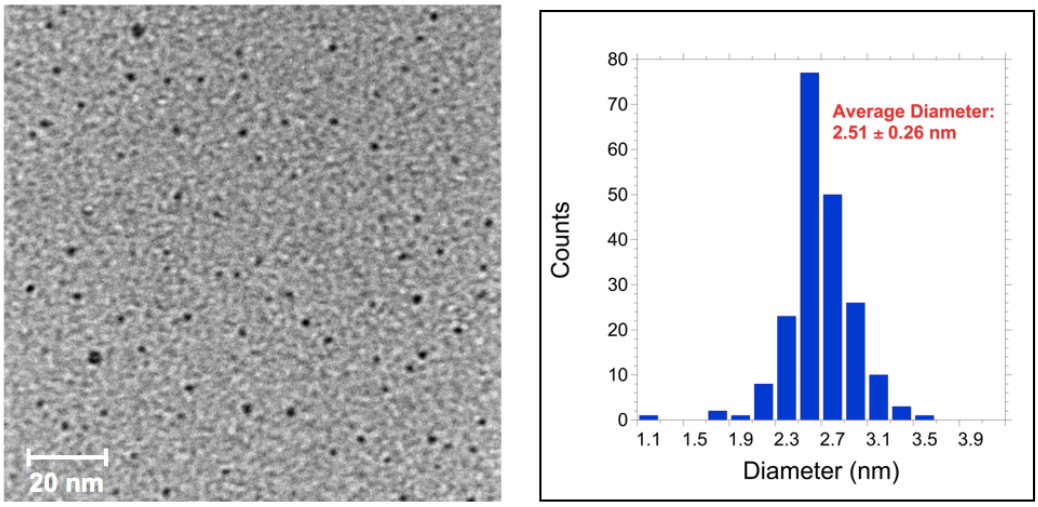


Fig. S1-1 TEM image of ZnO NPs in 2-Aminoethanol recorded using a JEOL, JEM-3200 electron microscope operated at 300 kV and corresponding size distribution histogram.

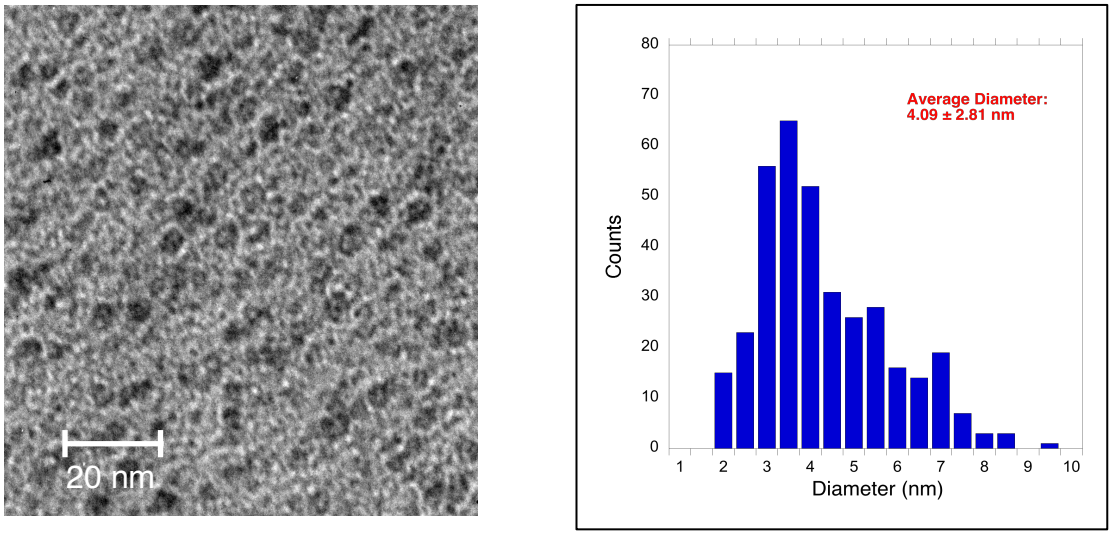


Fig. S1-2 TEM image of ZnO NPs in ethylene glycol recorded using a JEOL, JEM-3200 electron microscope operated at 300 kV and corresponding size distribution histogram.

S2. UV-vis Spectroscopy

We have measured ZnO film on fused silica (amorphous quartz), in order to see clear differences especially in the UV region among ZnO films with different annealing temperatures. We have found that our supplementary measurement corroborates UV-vis measurement done on ZnO ITO/Glass. Although due to the nature of our ZnO film being extremely thin, the measurement is difficult to differentiate, significant trend of ZnO film being less transparent with increase in annealing temperature is observable.

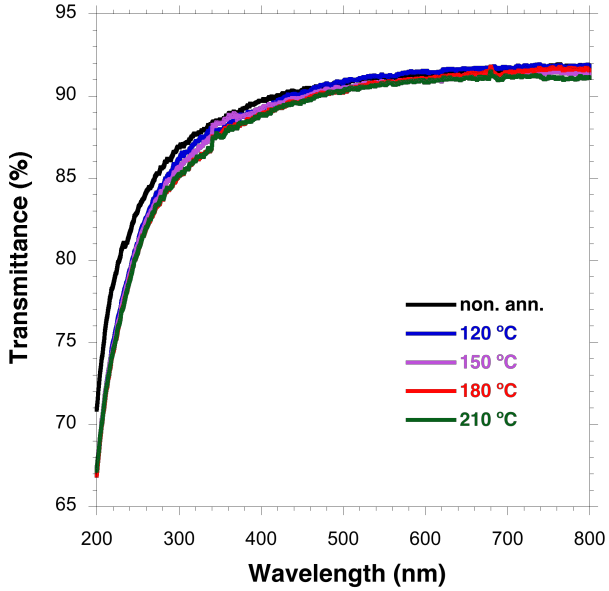


Fig. S2 UV-vis spectra of ZnO films on fused silica substrates.

S3. ZnO NPs in ethylene glycol based solar cell device

Device performance of ZnO NPs in ethylene glycol. (Fig. S3) They show limited performance due to low FF and Voc which we attribute to the bigger and less uniform ZnO NPs.

Annealing Temperature	V_{OC} V	J_{SC} mA/cm^2	FF	η %	R_s Ω cm^2	R_{sh} Ω cm^2
NA	0.48	9.04	0.43	1.9	8.07	4260
150 ºC	0.48	9.63	0.40	1.9	28.7	2790
210 ºC	0.46	8.99	0.43	1.8	17.9	832

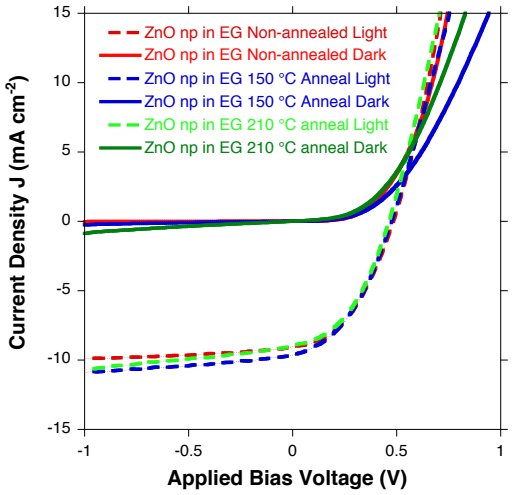
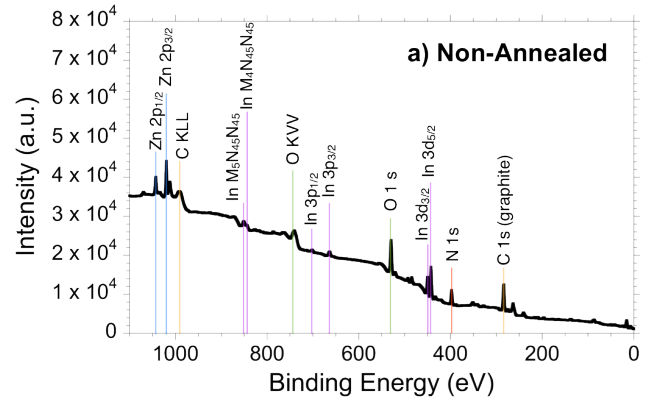
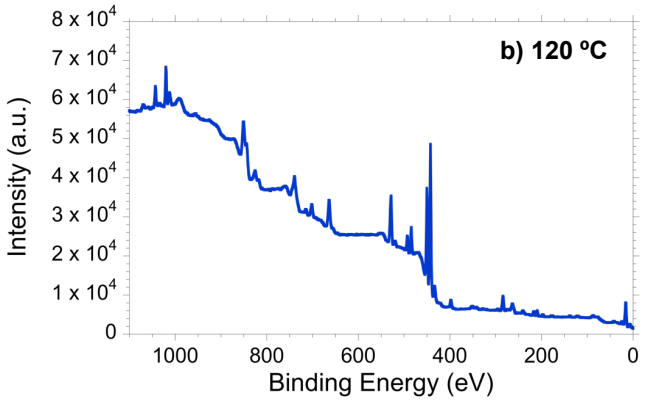


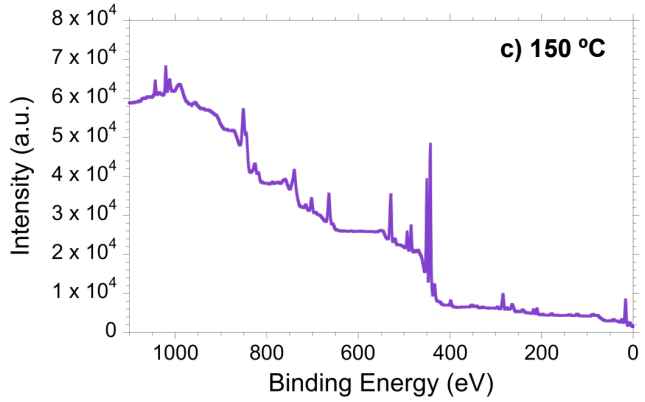
Fig. S3 Performance table and J-V curve of ZnO NPs in ethylene glycol based OSCs

S4. Wide-scan X-ray Photoelectron Spectroscopy

Full wide-scan spectra for each ZnO films are displayed below, with the relevant peaks assigned in the non-annealed film (Fig. S4a).







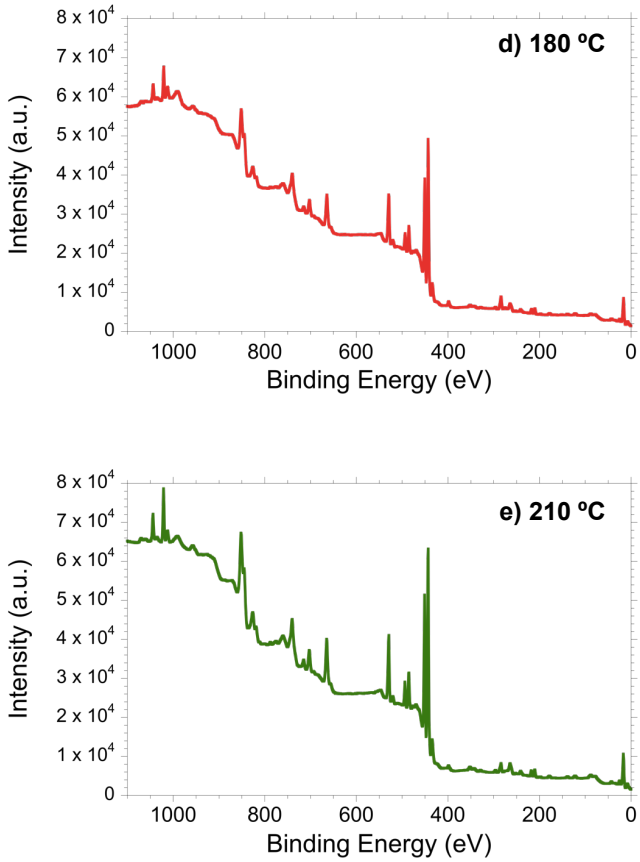


Fig. S4 XPS spectra recorded between binding energies of 0 and 1100 eV.