Supporting Information for:

Solution-processed, inverted organic solar cells with bilayered inorganic/organic electron extraction layers

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1. X-ray Photoelectron Spectra (XPS)

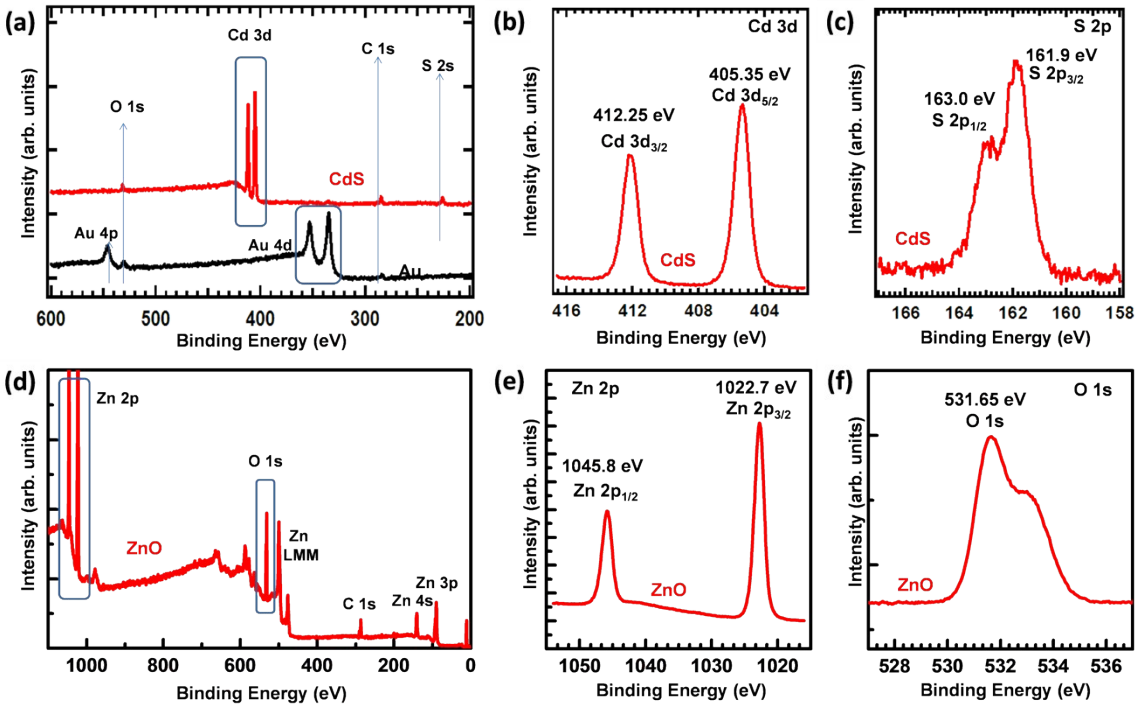

Figure S1. X-ray photoelectron spectra for CdS (a-c) and ZnO films (e-f) prepared using the same conditions as in PV devices. Figures (a,d) show surveys, while (b, c, e, f) show close-ups of the Cd 3d, S2p, Zn 2p and O 1s regions, respectively.

2. X-ray Diffraction Patterns (XRD)

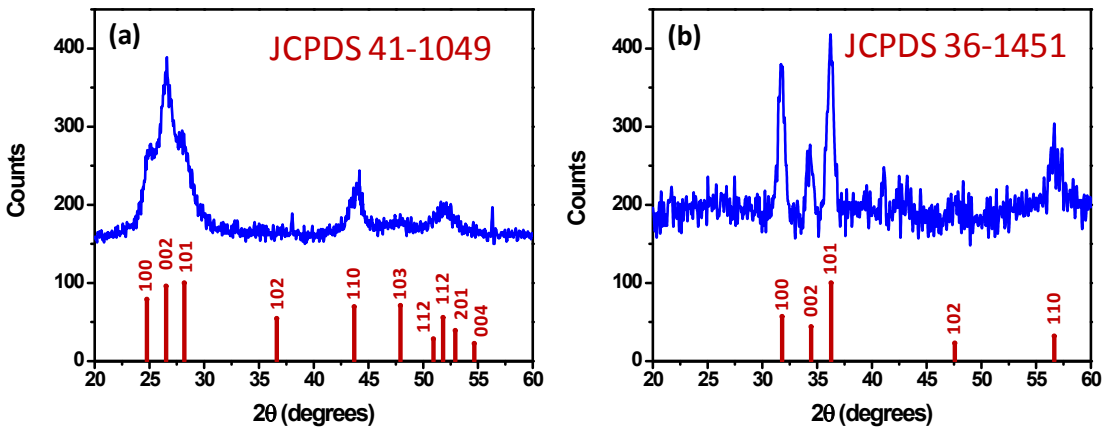

Figure S2. X-ray diffraction patterns for (a) CdS and (b) ZnO films prepared using the same conditions as in PV devices.

3. Water contact angle measurements

To examine the effect of surface energy on the device properties, water contact angle (θ) measurements were carried out using water droplets on ITO substrates and images were collected with a digital camera. As shown in Fig. S1a, The ITO substrate surface (θ ≈ 37 °) was hydrophilic. In contrast, the surfaces with interfacial layers showed increased hydrophobicity (θ > 37 °) compared to the pristine ITO surface. The CPE layer showed only a slight increase in contact angle (38 °), indicating that thin CPE layer only slightly increases the hydrophobicity. The ZnO also exhibited only a slight increase in contact angle to 39 °, indicating that ZnO surface is only slightly less polar than ITO. In contrast, the CdS layer showed a significantly higher contact angle of 57 °, which is consistent with the lower electronegativity of S compared to O and the more covalent nature of the CdS solid. Interestingly, the contact angle of the ZnO increased dramatically upon deposition onto the ZnO film to 49 °. This indicates that the CPE self-assembles onto the ZnO film to yield a more hydrophobic surface, suggesting that the ionic functionalities of the CPE align with the polar ZnO surface, while the non-polar polymer backbones are exposed at the top surface. The CdS/CPE film similarly showed an increase in hydrophobicity to 69 °, also indicating that the CPE interacts with the CdS film to increase the hydrophobicity of the surface.

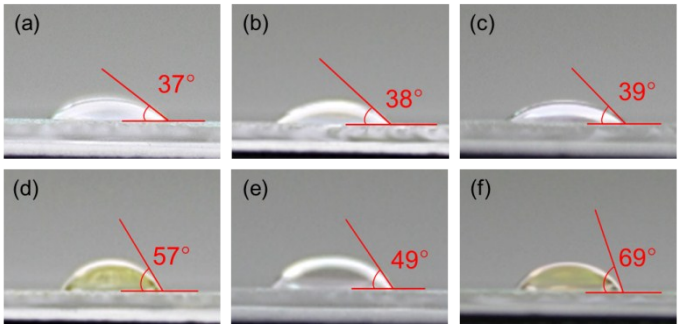

Fig. S3 Photos of water droplets on the surfaces of (a) ITO, (b) CPE, (c) ZnO, (d) CdS, (e) ZnO/CPE and (f) CdS/CPE substrate.