

Co-solvent Enhanced Zinc Oxysulfide Buffer Layers in Kesterite Copper Zinc Tin Selenide Solar Cells

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Supporting Information:

S1: Data from literature survey with 121 E_g values from peer reviewed journal articles compiled along with their corresponding ion concentrations. Additional information such as references and ligand type is also provided in SI file ZnS_CBD_Data.csv.

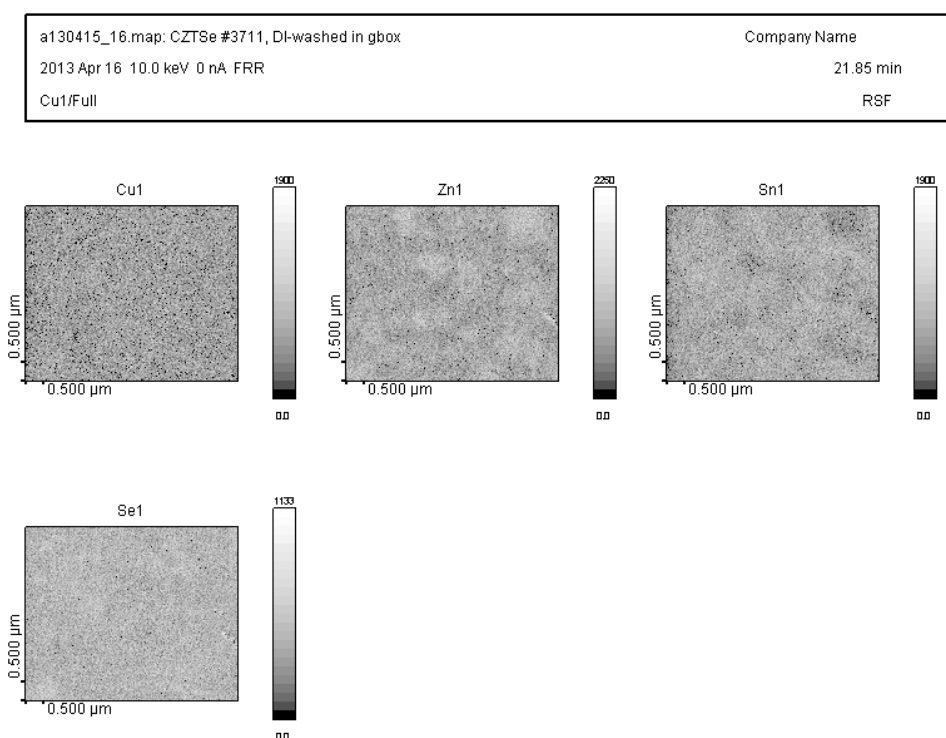


Figure S2: Auger electron spectroscopy map of Cu, Zn, Sn and Se. Slight variations in intensity are due to the rough polycrystalline film surface.

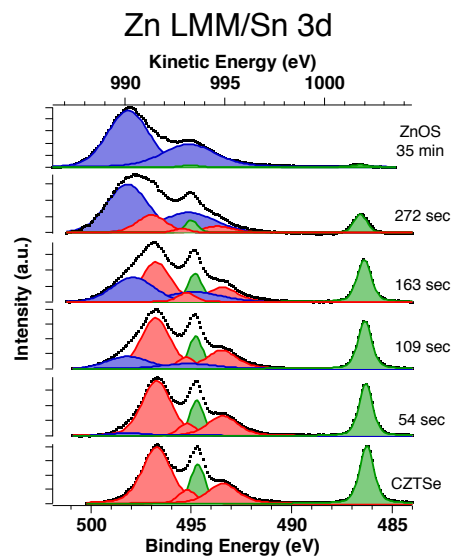


Figure S3: Zn LMM lineshape analysis showing distinct chemical environments for CZTSe and CBD-ZnOS.

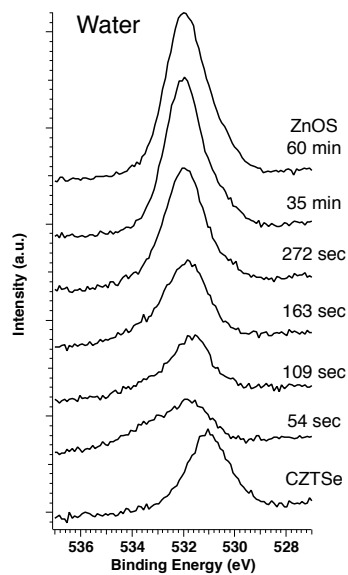


Figure S4: CZTSe/CBD-ZnOS layer-by-layer XPS of O 1s showing removal and/or conversion of surface oxide and subsequent ZnOS growth. The film ends in largely ZnOS with some ZnO evidenced by the low BE tail.

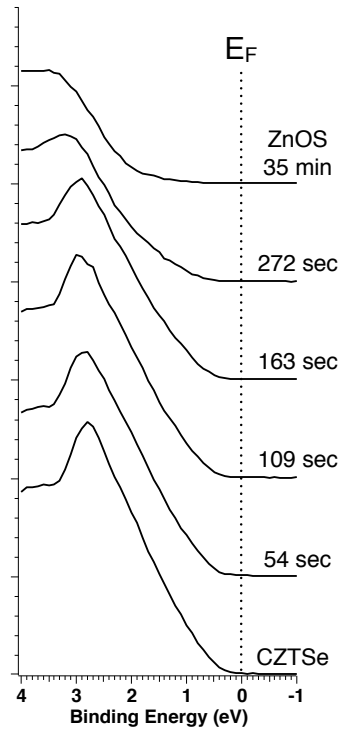


Figure S5: Representative VB spectra for CZTSe/ZnOS heterojunction formed layer-by-layer.

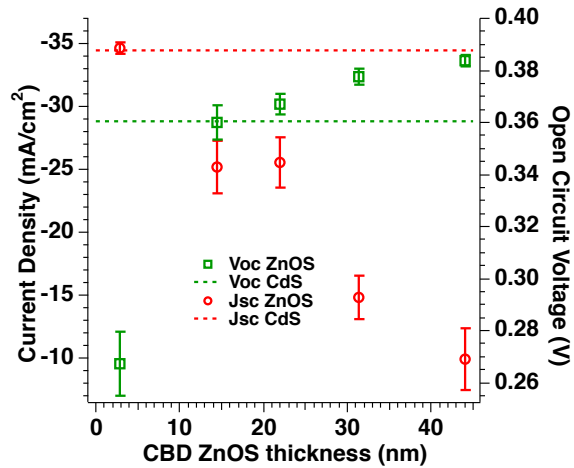


Figure S6: Thickness dependence of J_{sc} and V_{oc} for devices made with water+DMSO CBD-ZnOS buffer layers. V_{oc} and J_{sc} for optimized CdS buffered devices is shown for comparison (dashed lines). The CdS buffered device reaches over 8% power conversion efficiency with V_{oc} of 0.36 V and J_{sc} of 34.5 mA/cm². V_{oc} increases as the buffer nucleates and fills in to cover the absorber surface and matches the CdS performance. However, J_{sc} falls quickly as the buffer thickness increases.