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Effect of interfacial modification of organophosphonate-based self-assembled monolayers on the performance of inverted hybrid ZnO:P3HT photovoltaic devices LUISA WHITTAKER-BROOKS, WILL MCCLAIN, Princeton University, ARTHUR WOLL, Cornell University, JEFFREY SCHWARTZ, YUEH-LIN (LYNN) LOO, Princeton University — Hybrid organic-inorganic photovoltaics have not lived up to their promise because of our poor handle of the exciton dissociation interface. Interfacial modification based on self-assembled monolayer (SAM) adsorption provides a way of improving device performance. Here, we provide the first examples of a stepwise functionalization methodology that allows binding of phosphonic acid derivatives to ZnO nanowire arrays with minimal surface degradation and etching. We examined different adsorption methods; SAM adsorption via tethering-by-aggregation-and-growth (T-BAG) yields the most robust surface-bound monolayers. Poly(3-hexylthiophene), P3HT, infiltrated in surface modified ZnO nanowire arrays yielded functional hybrid solar cells with power conversion efficiencies as high as 2.1% due to improvements in both the short-circuit current density (Jsc) and the open-circuit voltage (Voc). The increase in Jsc can be attributed to enhanced charge transfer with surface passivation of ZnO, while the increase in Voc is attributed to the interfacial dipole introduced and improved P3HT wettability on ZnO with SAM adsorption.

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