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Metal Hydroxide Electron-selective Interlayers for Solution-processable Bulk Heterojunction Solar Cells

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We show here how highly efficient inverted bulk heterojunction organic solar cells can be fully solution processed using highly efficient electron extraction interlayers composed of inexpensive metal hydroxides (e.g., LiOH, NaOH, KOH and Ba(OH))We show that these solution processed alkali hydroxides successfully reduce the work function of the bottom contact and are further proven to effectively passivate defect states at the contact interface. We use photoelectron spectroscopy (X-ray and UV) to elucidate the chemical and energetic aspects of the contacts and their energetic alignment with a prototypical electron transport material (i.e., C60 molecules appear to be negatively charged (reduced) at the near surface region due to Fermi level equilibration with the low work function metal hydroxide contacts, providing for beneficial energy level alignment for electron extraction in solar cell devices. If next generation semiconductors (e.g., organic and hybrid materials) are going to become a viable option for solar energy technologies, the materials and fabrication procedures need to be significantly less expensive compared to established high efficiency technologies (e.g., Si.) Since these next generation materials are solution processable, roll to roll fabrication technologies can be utilized to reduce production cost by offering the ability to significantly increase module throughput and decrease processing temperatures. The air stable, solution processable and inexpensive alkalihydroxide interface modifiers presented here provide an enabling technology to afford environmentally stable, inexpensive low work function contacts for next generation solar cells.