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Small Molecules for Large-Area Applications

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Because of their inherent narrow and tunable absorption properties, organic semiconductors are particularly suited for use in unconventional solar cells, such as visibly transparent devices that can be deployed in buildings-integrated applications. We report solar cells with record single-junction photovoltages that use organic active layers designed to selectively harvest near-ultraviolet (near-UV) light while transmitting visible and near-infrared light. Cells comprising contorted hexabenzocoronene (cHBC) derivatives as electron donor and acceptor produce up to 100% more power per harvested UV photon than conventional crystalline silicon cells. Power generation in these solar cells is scalable with area while architectural simplicity, fabrication and integration ease for large-area applications is retained through their single-junction structure. Integration with electrochromic windows thus enables intelligent management of the solar spectrum, with the solar cells harvesting near-UV photons to power the regulation of visible and near-infrared photons for natural lighting and heating purposes.