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Photovoltaic cell efficiency improved with semiconductor crystals in ball-and-socket shape: Photovoltaics are expected to play a major role in satisfying the long-term global demand for cheap and renewable energy. Within the broad and diverse photovoltaic field, organic small molecules are particularly promising materials. While organic photovoltaics (OPVs) are attractive as materials for conversion of sunlight into electrical energy, higher conversion efficiencies are needed for OPVs to become a commercially viable technology. Crucial to improving the efficiency of photovoltaics is improving the interface between the hole and electron transporting films.

Semiconductor layers used to synthesize ball-and-socket interfaces for photovoltaic cells: This technology uses hexabenzocoronenes (HBCs) as p-type semiconductors and buckminsterfullerenes (C60) as n-type semiconductors to form semiconductor layers to synthesize ball-and-socket interfaces for bilayer and bulk heterojunction devices. HBCs have an unusual shape that is contorted and doubly-concave. As a result, their size and shape are complementary to that of C60. When mixed, the two co-crystallize, forming an interdigitated supramolecular complex with either a repeat pattern of ABAABA or ABAB, depending upon the crystallization conditions. Crystals formed from contorted HBCs as used here are shown to dramatically outperform flat HBC crystals because flat-HBCs do not complement C60 as well as contorted ones. This demonstrates that shape complementarity is crucial to improving the photovoltaic properties of OPVs.

Applications:
• Organic photovoltaics
• May be partnered with longer wavelength absorbing layers to achieve higher efficiency solar cells

Advantages:
• Largest open circuit voltage reported for organic photovoltaics
• Improving shape complementarity is a relatively simple route to improving OPV efficiencies


Licensing Status: Available for Sponsored Research Support

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