Technology Offer

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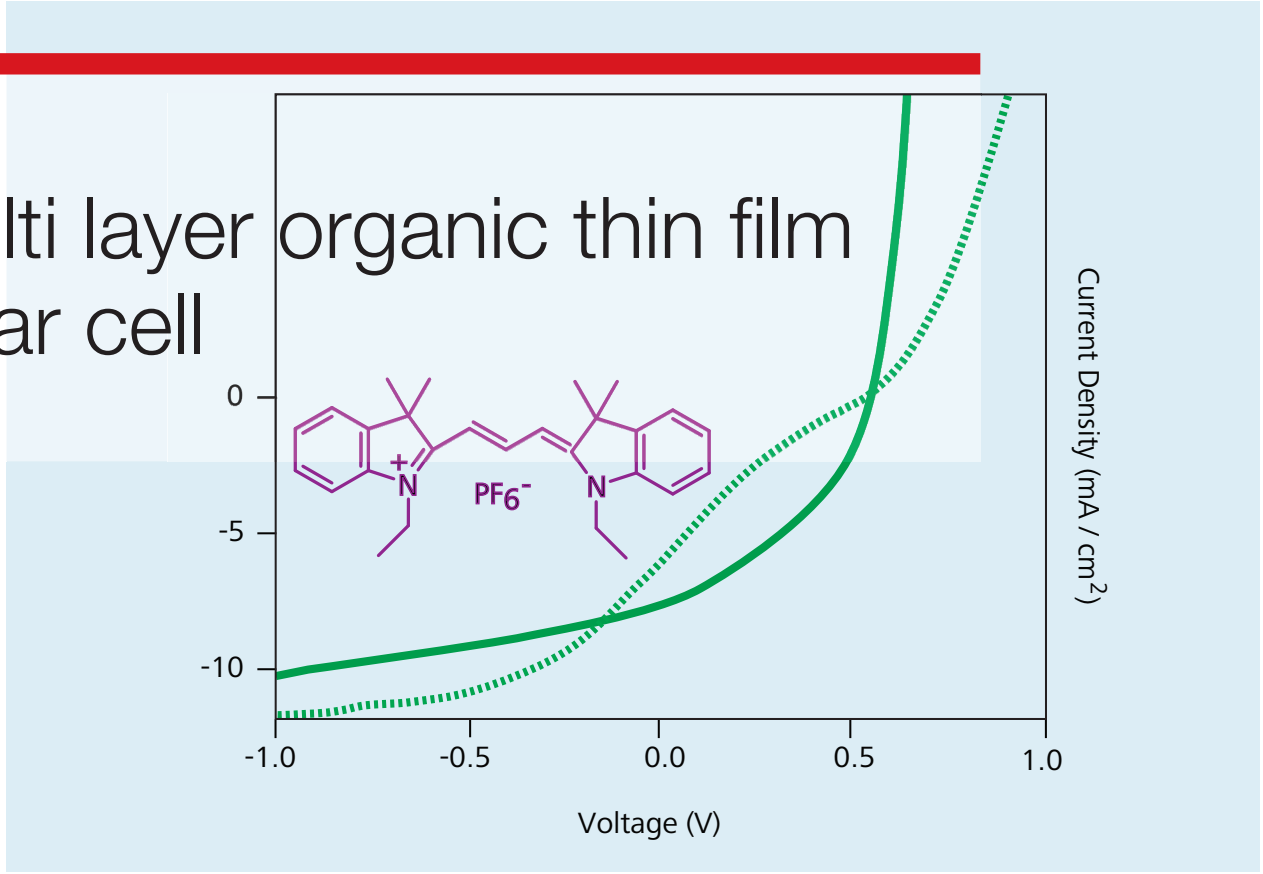
EMPA
Materials Science & Technology

Multi layer organic thin film solar cell



Current-voltage characteristics of cyanine dye / fullerene solar cells fabricated without (dashed line) and with (solid line) an energy matching salt layer to facilitate hole extraction according to the invention

Invention

The invention describes multi layer organic solar cells with improved charge-collection and power conversion efficiency. Device improvement is achieved by using a thin organic or inorganic salt layer to adjust the electronic levels of adjacent layers.

Background

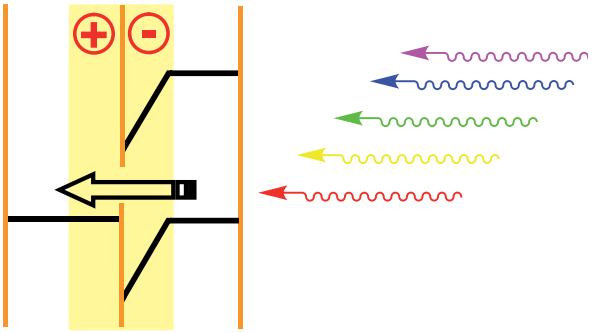
Solution-processed organic solar cells are promising devices for inexpensive, large-scale solar energy conversion. Recent work has demonstrated that by use of soluble small organic molecules, multi layer devices with high power conversion efficiencies can be fabricated. Semiconducting materials with matched electronic and optical functionalities are one obvious requirement for high light to electrical charge conversion. In addition, efficient charge collection requires the proper matching of the electrode work functions to the charge-transporting states in the organic material. Our invention describes a simple process to match the electronic structures at interfaces, thereby facilitating the critical charge transfer.

Advantages

A great variety of salts may be used and are appropriate to adjust the intermediate matching layer. The principle can be used to tune the energy mismatch between any two interfaces in a multilayer device. Our invention allows the fabrication of solar cells with long lifetimes using a fast, cheap and simple manufacturing method.

Applications

Large scale production of cyanine dyes is already occurring, which promises competitive materials prices for the emerging organic solar cell technology. We applied thin salt layers in cyanine dye / C_{60} bilayer photovoltaic devices between the conductive anode layer and the cyanine layer to reduce the energy offset. Thereby, hole injection was facilitated and the power conversion efficiency increased markedly. Cyanines belong to the class of polymethine dyes and are characterized by high solubility, low tendency to crystallization such as tunable and very strong light absorption. We emphasize that the method is not restricted to the material system used in our invention, but can in principle be applied to any organic or inorganic multicomponent system where facile charge transfer across selected heterointerfaces has to be assured.



Thin films of organic or inorganic salts can be used to match energy levels (black lines) between adjacent layers in organic solar cells.

Ownership

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Keywords

organic solar cell, cyanine dye, energy matching layer, salt layer

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