The Summer Undergraduate Research Fellowship (SURF) Symposium
7 August 2014
Purdue University, West Lafayette, Indiana, USA

Radical Polymers as Anodic Charge Extraction Layers in Small Molecule Organic Photovoltaic Devices

Krystopher S. Jochem, Aditya G. Baradwaj, and Bryan W. Boudouris
Chemical Engineering, Purdue University

ABSTRACT

Organic photovoltaic (OPV) devices based on the copper (II) phthalocyanine(CuPc)/ fullerene(C_{60}) system are an innovative photovoltaic technology optimal for situations requiring low-cost, transparent, and flexible devices. Furthermore, the high degree of reproducibility of this system allows for the ready study of new OPV technologies. Here, we have used this system to elucidate systematic structure-property-performance relationships for a new OPV anode modifier. The addition of interfacial modifier materials between the organic CuPc/C_{60} layers and the metallic anode drastically can improve efficiency. Radical polymers are a class of polymers with aliphatic backbones and pendent stabilized radical groups. Here, we utilize poly(2,2,6,6-tetramethylpiperidinyloxy methacrylate) (PTMA) to examine the feasibility of radical polymers as anode modifiers. OPV devices utilizing a PTMA thin film deposited onto an ITO substrate (anode) with subsequent CuPc and C_{60} active layers followed by a BCP cathode modifier and an aluminum layer (cathode) were fabricated using thermal evaporation. Device performance was evaluated by measuring current density as a function of voltage during simulated solar radiation. Addition of a thin layer of PTMA between the ITO and CuPc layers increased device power conversion efficiency to approximately 0.95% from a control of 0.57%, likely due to enhancement of the crystal structure of the CuPc layer. The addition of interfacial modifiers significantly increases the overall efficiency, and consequently, viability of CuPc/C_{60} OPV devices, and this logic should be extendable to a myriad of other polymer based solar cell designs.

KEYWORDS

CuPc, C60, Radical Polymers, Organic Photovoltaic Device, Small Molecule Solar Cell

REFERENCES

Na-Na, W., Jun-Sheng, Y., Yue, Z., Ya-Dong, J. (2010). Photocurrent analysis of organic photovoltaic cells based on CuPc/C60 with Alq3 as a buffer layer. *Chinese Physics B.* 19, 038602.

Sullivan, P., Jones, T., Ferguson, A. Heutz, S. (2007). Structural Templating as a route to improved photovoltaic performance in CuPc/C60 heterojunctions. *Applied Physics Letters.* 91, 233114.

Armstrong, N., Carter, C., Donley, C. (2003). Interfacial Modification of ITO thin films: organic photovoltaic cells. *Thin Solid Films.* 445, 342.