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High efficient fully printable organic-inorganic hybrid bulk heterojunction thin-film solar cells based on metal-alkoxides

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Photovoltaic cells, which are expected to serve as a clean and renewable energy source, are among the most abundant technologies for energy on earth besides hydropower and wind power. On the other hand, organic-inorganic hybrid thin-film solar cells constructed using polythiophene derivatives and metal alkoxides constitute promising and novel organic-inorganic hybrid devices. We have reported some organic-inorganic bulk heterojunction solar cells with several p-type semiconducting polymers and Ti-alkoxides for the photoactive layer. These solar cells involve low fabrication cost and use safe materials but their conversion efficiency is not very high. One reason for this is that the phase-separated structure is not controlled adequately for utilization in exciton generation and diffusion, charge separation and charge transportation. Therefore, we present a three-component layer as the photoactive layer using the phase-separation assistant material. Organic-inorganic hybrid thin-film solar cell structure consists of indium-doped tin oxide transparent conductive film, photoactive layer (p-type semiconducting polymer/TiOx/fullerene derivative as the phase separation assistant material) and organic electrode. The current density and voltage characteristics were measured using a direct-current voltage and a current source/monitor under illumination with AM 1.5G simulated solar light at 100 mW/cm^2. The phase-separated structures of the photoactive layers were investigated by scanning electron microscopy. The three-component bulk heterojunction solar cell with the p-type semiconducting polymer/TiOx/fullerene derivative structure as a photoactive layer exhibited higher current density than the conventional two-component solar cell.

Biography

Takehito Kato is an Associate Professor of Mechanical Engineering in National Institute of Technology, Oyama College, Japan. He has received his PhD in 2007 at Kyushu Institute of Technology, Japan and had been a Researcher at Sumitomo Chemical Co. Ltd. during 2007-2012. His current research focuses on morphology control of organic-inorganic hybrid phase structure and energy conversion devices based on organic-inorganic hybrid materials. He has published articles in several international peer-reviewed journals and attended more than 100 national and international conferences. Furthermore, he has published over 60 patent applications.

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