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Morphology control for nano phase separation structures and application to electronic devices

Recent years have witnessed extensive research for the development of electronic devices such as solar cells, thermal electrical conversion devices and light-emitting devices comprising organic and organic-inorganic hybrid materials. For these applications, research targets are efficiency, stability and function. Hence, morphology control has emerged as an important research topic. The effect of the morphology control of nanophase separation structures in the photoactive layer of organic thin-film solar cells and organic-inorganic hybrid thin-film solar cells, from the viewpoint of nanotechnology. Photovoltaic cells, which expected are to serve as a clean and renewable energy source, are among the most abundant technologies for harnessing energy on earth, besides hydropower and wind power. Particularly, organic and organic-inorganic hybrid solar cells exhibit potential advantages like low manufacturing cost, low weight and mechanical flexibility. These solar cells typically contain two electrodes and one photoactive layer. The photoactive layer is composed of bulk heterostructures of a p-type semiconducting material as the electron donor and an n-type semiconducting material as the electron acceptor. The typical thickness of a photoactive layer is of the order of a few hundred nanometers. Irrespective of the thickness of the film, the photoactive layer performs several functions such as light absorption, exciton generation and diffusion, charge separation and transportation. The exciton diffusion length for charge separation is approximately 10 nm, which is very short. Therefore, the size of the electron donor phase in the bulk heterostructure of the photoactive layer controlled should be around 10 nm. Furthermore, after charge separation, the charge carriers have to move to both electrodes. Hence, the phases of the electron donor as well as acceptor should be continuous in each electrode. In this viewpoint, our research group reported on the effectiveness of molecule bulkiness and the solubility parameter of materials used for the morphology control of nano phase separation structures. The nanotechnology of morphology control will immensely aid in the development of novel electronic devices and functional materials in various fields.

Biography

Takehito Kato is an Associate Professor of Mechanical Engineering at Oyama College, National Institute of Technology, Japan. He has completed his PhD from the Kyushu Institute of Technology, Japan. He has worked as a Researcher at Sumitomo Chemical Co., Ltd. from 2007 to 2012. His current research focuses are on the morphology control of organic-inorganic hybrid phase structures and energy conversion devices based on organic-inorganic hybrid materials. His research group works on medical photo sensors, photovoltaic cells and thermal electrical conversion devices. He has published several international peer-reviewed journals and attended more than 100 national and international conferences. He has also published over 60 patent applications.

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