27p-PA1-5

Stability of Mesogenic - Phthalocyanine - Based Bulk Heterojunction Solar Cell

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はじめに：　A mesogenic phthalocyanine derivative, 1,4,8,11,15,18,22,25-octahexylphthalocyanine ($C6PcH_2$) has been demonstrated as a promising small molecule for use in bulk heterojunction (BHJ) solar cells.[1] $C6PcH_2$ exhibits not only excellent processability for thin films but also appropriate electronic characteristics for a solar cell, such as a deep highest occupied molecular orbital energy level, a relatively small band gap, strong optical absorption, and high hole and electron drift mobilities exceeding 1.4 $cm^2V^{-1}s^{-1}$ and 0.5 $cm^2V^{-1}s^{-1}$ in the crystalline phase, respectively. In the simple structure, solar cells, the active layer of which was composed of $C6PcH_2$ and a fullerene derivative, 1-(3-methoxy-carbonyl)-propyl-1-1-phenyl-(6,6)C61 (PCBM), showed a high performance and high stability. [2] Herein, we clarify mechanism of stability on mesogenic-phthalocyanine-based BHJ Solar Cell.

実験：　MoO_x films were thermally evaporated onto ITO substrates. A solution containing a mixture of $C6PcH_2$:PCBM (2:1) in toluene or chloroform was spin-cast onto a MoO_x layer. A similar process was performed to fabricate the P3HT-based devices. Finally, a LiF buffer layer and an aluminum layer were deposited through a shadow mask by thermal evaporation.

結果：　Fig. 1 shows the cell characteristics of the based devices stored in the air as a function of time, when illuminated by a solar simulator. Obviously, the efficiency is correspondingly fallen to the short – circuit current and decreased to 70% after 12-hour illuminating. It exhibits the high stability of the $C6PcH_2$ based devices, compared with polymers based ones which decreased to 60% after 9-hour illuminating by solar simulator. [2] The $C6PcH_2$ and PCBM composite thin films have also been characterized by XPS and XRD. It exhibited that the bonds of nitrogen atoms at twofold-coordinated nitrogens: the two pyrrole aza nitrogens, denoted as N2 in Fig. 2, and the four meso-bridging aza nitrogens, denoted as N3 with neighboring carbons were broken, or the $C6PcH_2$ rings were opened.

謝辞：　本研究は JST 先端的低炭素化技術開発(ALCA)の援助の基に行われた。

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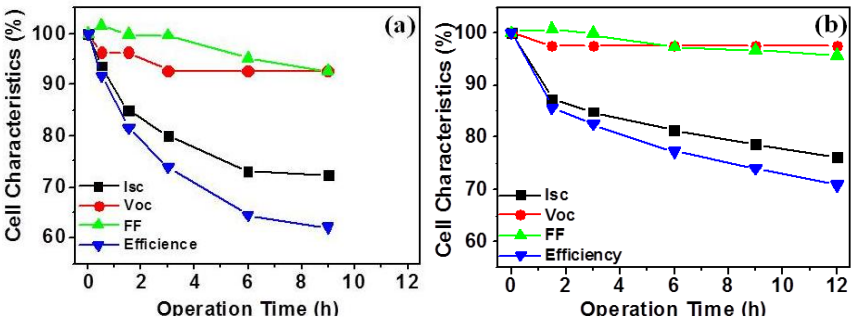

Fig. 1: Characteristics, normalized by their initial values, as a function of illumination time, of solar cells fabricated utilizing (a) P3HT and (b) $C6PcH_2$

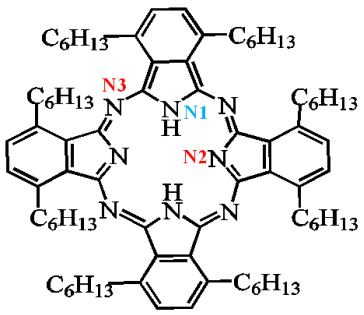

Fig. 2: Molecular structure of $C6PcH_2$