Michio MATSUMURA, Professor

Research Center for Solar Energy Chemistry, Osaka University
1-3 Machikaneyama, Toyonaka, Osaka 560-8531, Japan
Tel: 81(Japan)-6-6850-6695, FAX 81-6-6850-6699
E-mail: matsu@chem.es.osaka-u.ac.jp

Education

Ph. D. (January, 1980), M. Eng. (March, 1974), B. Eng. (March, 1972): Osaka University

Academic and Professional Career

1976 (April): Assistant Professor, Department of Chemistry, Faculty of Engineering Science, Osaka University

1985 (April): Lecturer (Associate Professor), School of Engineering Science, Osaka University

1989 (April): Head of New Materials Research Department, International Research Laboratory, Ciba-Geigy, Japan

1992 (October)-: Professor, Research Center for Solar Energy Chemistry, Osaka University

2010 (April)-: Director of Research Center for Solar Energy Chemistry, Osaka University

Total Publications

179 original papers

Research Interests

The development of a basic strategic response to our continually dwindling energy resources and to environmental problems which are prevalent on a global scale is perhaps the most important research theme for present day science and technology. Research Center for Solar Energy Chemistry was established in 1991 in Osaka University under the expressed purpose of advancing the research that will resolve these issues through the use of solar energy. As a professor of this Research Center, Prof. Matsumura has engaged in studies on solar cells and photocatalyts. His research subjects include (1) non-vacuum (or low-cost) processes for fabrication of inorganic thin film solar cells, (2) internal structure of organic thin film solar cells, (3) new methods for texturing crystalline Si solar cells, (4) mechanisms of TiO_2-photocatalyzed reactions, and (5) synthesis of nanoparticles for photocatalyts and catalysts.

Interpenetration of Components across Interface of Organic Bilayer Solar Cells

Risa Sakai, Shigeru Ikeda, and Michio Matsumura

Research Center for Solar Energy Chemistry and Department of Materials Engineering Science, Graduate School of Engineering Science, Osaka University
Toyonaka, Osaka 560-8531, Japan
matsu@chem.es.osaka-u.ac.jp

Efficiencies of organic solar cells have been increasing rapidly.　It was this June that Mitsubishi Chemicals announced the achievement of milestone of 10% efficiency.　To increase the efficiency both materials and internal structure of organic layers are important. Most of the organic solar cells are made of two components: an electron donor and an electron acceptor.　The combination determines the photovoltage.　It is known that photocurrent depends not only on the combination but also on special arrangement of the two components in organic films.　However, since the analysis of the special arrangement of organic components is usually difficult, the methodology for controlling the arrangement is not well established.

We have studied solar cell properties and morphological changes of poly(3-hexyl thiophene) (P3HT） and (6,6)-phenyl C_{61} butyric acid methyl ester（PCBM）stacked layers by applying heat treatment at different temperatures. The photocurrent and efficiency reached maxima when treated at about 60 °C, as shown in Fig. 1(a). The morphology of the film also changed with temperature, suggesting that the two components interpenetrate at this temperature. We also detected increase in signal of sulfur due to the thiophene unit of the bottom layer with the increase of temperature through the top PCBM layer of the stacked films by XPS, as shown in Fig. 1(b).　This also suggests the interpenetration of the two components. Solar cell properties reach the maximum when the two components are interpenetrated ideally. However, when the interpenetration was too much, the asymmetric structure of the stacked layers, which is essential to the solar cells, is destroyed.

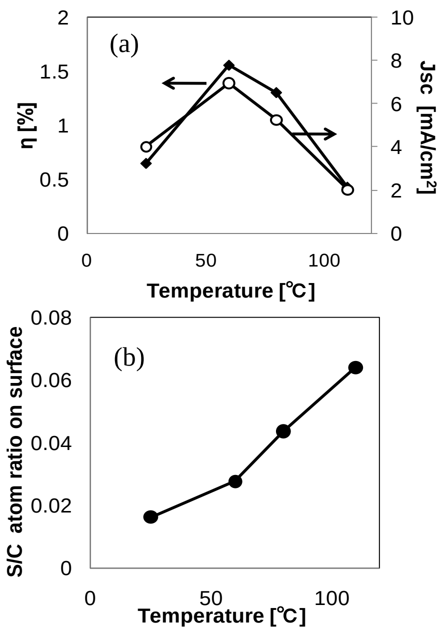

Figure 1. Effects of annealing on P3HT/PCBM stacked layers: (a) solar cell properties and (b) S/C atomic ratio measured by XPS.