Nanoscale Evaluation of Organic Solar Cells by Light-Modulated Scanning Tunneling Microscopy

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Organic thin-film solar cells are attracting attention in recent years because of their light weight, flexibility, low manufacturing cost, and so on. The conversion efficiency is, however, still not high compared to conventional silicon solar cells. Such thin-film organic solar cells have inhomogeneous structures and their power-conversion efficiency has spatial variation. Thus, in this study, we used "light-modulated scanning tunneling spectroscopy" (LM-STS) [1] to investigate the nanoscale conversion efficiency of those solar cells. LM-STS has nanoscale spatial resolution and reveals the local current-voltage characteristics of the samples under laser-irradiated and dark conditions.

In the LM-STS measurement, the sample surface under STM observation was intermittently illuminated by a super-bandgap laser light (530 nm), whose intensity was periodically switched between 5 levels (0%, 25%, 50%, 75%, 100%) every 10 ms during STS measurement, with which five IV curves reflecting the local sample band characteristics under the five illumination intensities was obtained. At the presentation, we discuss the relationship between the surface corrugation and the variety of local performance characteristics, i.e. band edge position, photocurrent, photovoltage and leak current measured on by LM-STS.

References:

[1] O. Takeuchi, S. Yoshida and H. Shigekawa, Appl. Phys. Lett. 84, 3463 (2004).

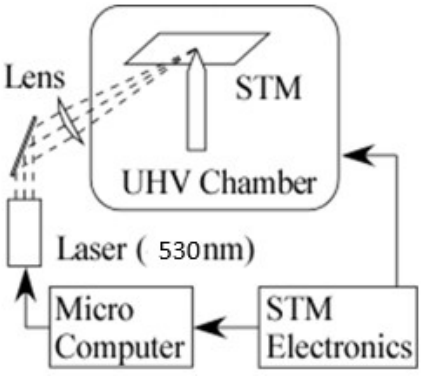

Fig1. Measurement setup of LM-STS

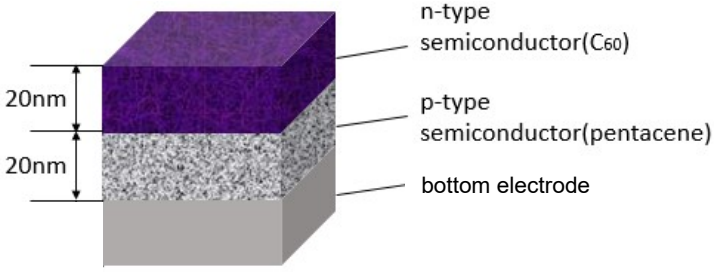

Fig2. Organic solar cell sample: n-type semiconductor is C_{60}(20nm), p-type semiconductor is pentacene(20nm).