Nanoscale Polarimetry with STM Light Emission on P3HT:PCBM Solar Cell

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Organic thin film solar cells (OSCs) are expected to be light-weighted, flexible, design friendly and cost efficient. Thus, it gathers attention in the development o sustainable energy sources. To maximize the active region for photoelectric conversion, a number of OSCs have complex bulk-hetero junction (BHJ) structures, where the interface between *p*-type and *n*-type semiconductor regions is heavily corrugated during the self-organizing phase separation. In an OSC device, the organic film with BHJ structure is sandwiched by a metal electrode and a transparent electrode. Thus, such nanoscale variations are not observable by an external measurement. To understand the nanoscale variation, however, is crucial for further improvement of conversion efficiency of OSC devices.

To investigate such nanoscale variation of efficiency in OSCs, we applied scanning tunneling microscopy light emission spectroscopy (STM-LES) on a naked OSC thin film without the metal electrode. In our experiment, instead of the planar metal electrode, STM metal tip works as the metal electrode. We inject electrons from the STM tip and holes from bottom transparent planar electrode to investigate the reverse process of an OSC, i.e. light emission by the recombination of electrons and holes in the organic thin film. With STM apparatus, we regulate injection current during measurement. Thus, we measured intensity and polarimetry of photon which emitted by OSC devices.

The figures show the typical STM-LES results on P3HT:PCBM BHJ OSC. We estimate that this Polarimetry reflects molecular orientation within P3HT:PCBM BHL OSCs. In the Presentation, we introduce that nanoscale light-emitting property with light emission intensity and polarimetry.

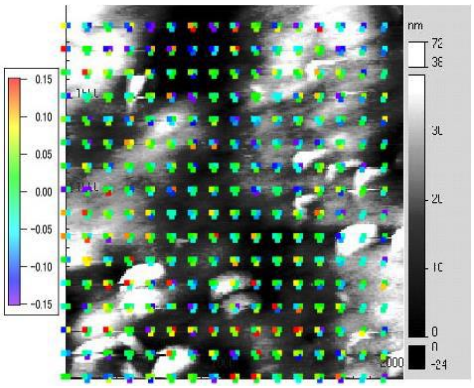

Fig.1: STM topography and Light emission intensity on P3HT:PCBM OSC. Light emission intensity is in a.u.

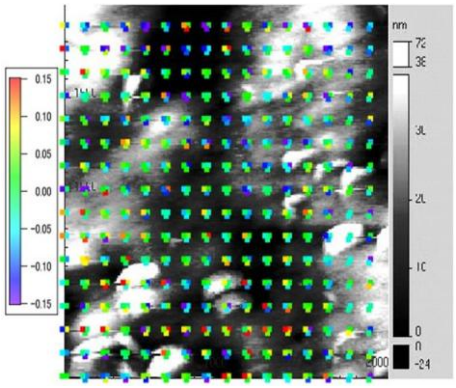

Fig.2: STM topography and Polarimetry on P3HT:PCBM OSC. Polarimetry intensity is in a.u.