Light emission from organic thin film solar cell measured by STM-LES

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Organic thin film solar cells (OSCs) have many desirable properties, i.e. cost efficient, resource saving, light weight, and mechanically flexible. OSCs with a bulk-heterojunction (BHJ) structure composed of blended p-type and n-type semiconductors increase the active region for charge separation and increase their conversion efficiency. A BHJ structure is inhomogeneous at the nanoscale. Thus, the performance of the device such as power conversion efficiency also becomes inhomogeneous at nanoscale. To improve the device performance of OSCs, it is important to study the relationship between the local device performance and the nanostructure.

In this study, we applied scanning tunneling microscopy light emission spectroscopy (STM-LES) to OSCs to investigate the local structures of the BHJ layer.We prepared for samples without the top metal electrodes and injected electrons locally from the STM tip and holes from the bottom transparent planar electrode to investigate the intensity and polarization of the light emitted from the organic nanocrystals.

The figures show the typical STM-LES results on P3HT:PCBM solar cell. We estimate that the polarimetry reflects molecular orientation within P3HT nanocrystals. At the presentation, we will discuss the correlation of the nanoscale structure of BHJ layer with their conversion efficiency.

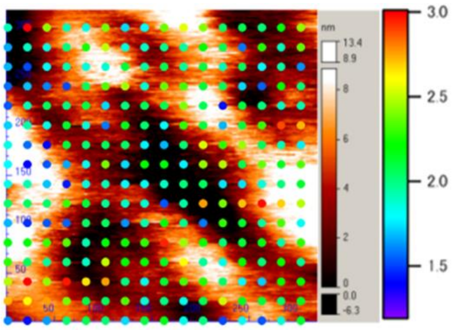

Fig1:STM topography and Light emission intensity on P3HT:PCBM OSC. Light emission intensity is in a.u.

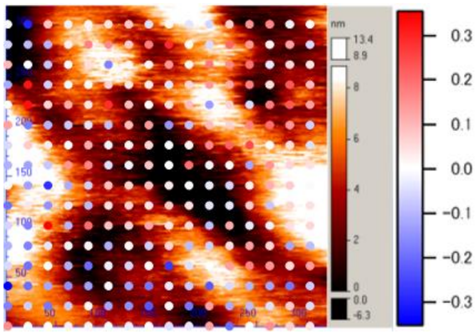

Fig.2: STM topography and polarimetry on P3HT:PCBM OSC. Polarimetry intensity is in a.u.