Rubrene Single Crystal Photovoltaic Cells Using Lateral Carrier Transport

Sureerat Makmuang[1,2], Mitsuru Kikuchi[1], Seiichiro Izawa[1], Masahiro Hiramoto[1]
1. Institute for Molecular Science, 2. Chulalongkorn Univ.
E-mail: sureerat@ims.ac.jp

Recently, we demonstrated a successful operation for lateral electron collecting organic photovoltaic cell using NTCDA single crystal[1)]. Electron range for NTCDA single crystal was determined to 30 μm. In this work, we adopted rubrene single crystal having 100 times higher carrier mobility compared with that of NTCDA (10^{-2} cm^2/Vs)[1)] to obtain longer carrier range, L (= μτE).

Cell structure is shown in Fig. 1. Electron collecting electrode underlying C_{60} film was evaporated on rubrene single crystal. Hole collecting electrode was evaporated at the 50 μm away from the hole collecting electrode.

Clear photovoltaic characteristics showing the open-circuit voltage (V_{OC}) of 0.35 V was observed for lateral hole-collecting-type cells having the electrode distance of 50 μm although the strength of electric field was only the order of several tens V/cm. This result suggests that holes photogenerated at the C_{60}/rubrene interface move the distance of 50 μm in lateral direction which is 1,000 times longer than that of 50 nm in vertical direction for electrons. Moreover, the effective hole transport occurred more than 50 μm in the lateral direction, namely, the hole range (L_h) was above 50 μm. Now, we are determining hole transport range (L_h) by varying the distance between lateral electrodes (L).

1) M. Kikuchi and M. Hiramoto et al., *Org. electron.*, **41**, 118-121 (2017).

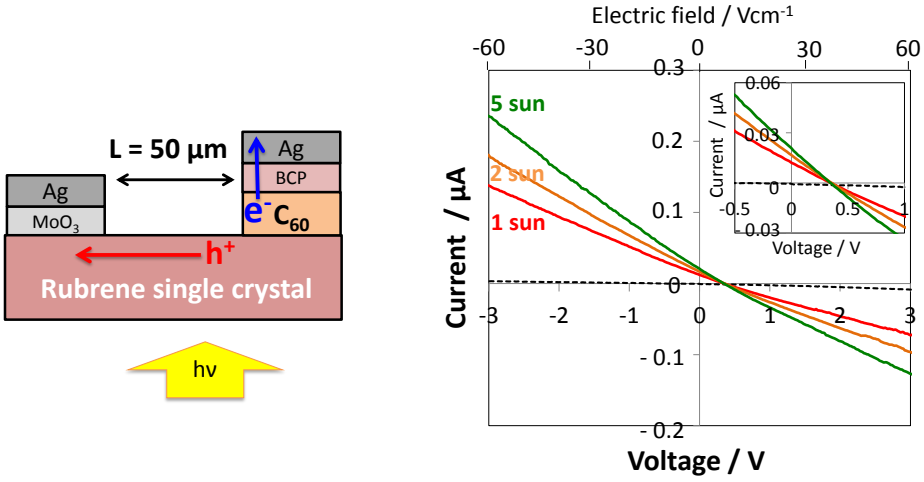

Fig. 1 (left) Lateral cell structure. (right) Current-voltage (J-V) characteristics of rubrene single crystal cell.