Gate-bias and Temperature Dependence in C8-BTBT Thin Film Transistor with Bilayer MoO_3/Au

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【Introduction】Organic thin-film transistors (OTFTs) have recently attracted a great deal of interest for organic electronic applications. Study on charge transport in OTFTs is one of the essential research in improving device performance of transistor. Particularly, the insertion of metal oxide, such as, molybdenum oxide (MoO_3), germanium oxide (GeO) and tungsten oxide (WO_3) between electrode/semiconductor interface can improve the hole injection and reduce contact resistance.[1)] Previously, we have reported on gate-bias and temperature dependence in pentacene-based OTFTs with MoO_3/Au electrode.[2)] In this study, by using same evaluation technique, we have investigated charge transport in C8-BTBT TFT with MoO_3/Au electrodes. C8-BTBT is a well-known material that have a wide band gap compare to pentacene and high injection barriers OTFTs. We have measured temperature dependence voltage-current (V_D-I_D) characteristics from 133 K to 293 K with different gate-bias voltage.

【Experimental】 The device were fabricated on n-type silicon substrate with 100 nm SiO_2 layer, using 40 nm C8-BTBT as the active layer in a top-contact structure. Finally, 5 nm MoO_3 and 50 nm Au were deposited as source and drain electrodes. The channel length (L) and channel width (W) were 0.5 mm and 1.5 mm, respectively. To investigate the charge transport mechanism, the device was cooled down using a cryostat. The V_D-I_D characteristic was measured in the temperature range between 133 K and 293 K by flowing liquid nitrogen into the vacuum chamber.

【Results and discussions】Figure 1 shows V_D-I_D characteristics with different V_G in the temperature range between 133 K to 293 K. From these results, I_D was decreased with decreasing temperature. By applying gate voltage, the activation energy decreases as negative gate voltage increases, as shown in Figure 2. Temperature dependence V_D-I_D characteristics also will be explained with two possible charge injection mechanism which are Schottky thermionic emission and “Polycrystalline model” at ground boundary.[3)]

【Conclusion】 We have investigated gate-bias and temperature dependence of top-contact C8-BTBT TFT by inserting the MoO_3 between C8-BTBT layer and source-drain Au electrodes.

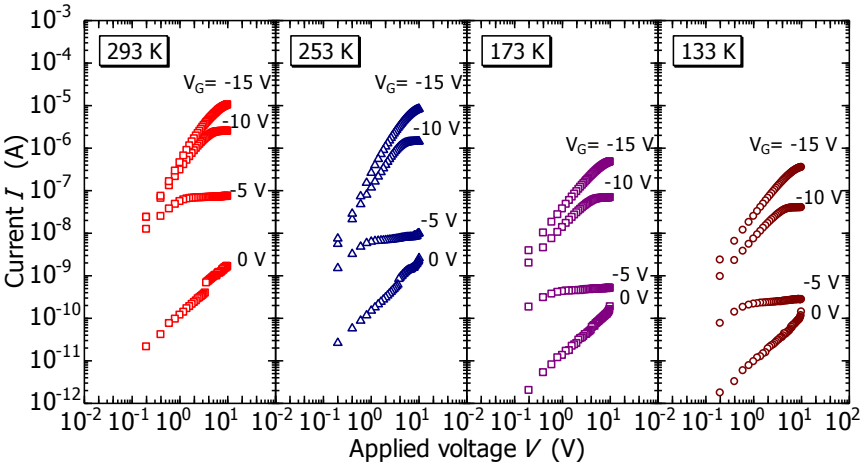

Fig. 1

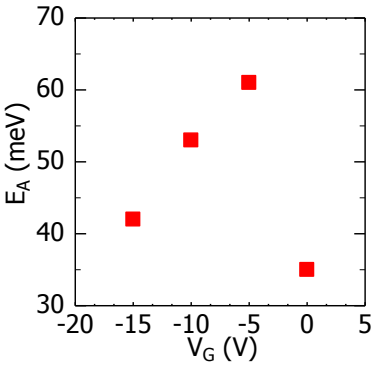

Fig. 2

【References】

1) M. W. Alam, Z. Wang, S. Naka and H. Okada: Current Nano Science **9**, 407 (2013).
2) S. Shaari, S. Naka, and H. Okada: The 63rd JSAP Spring Meeting, 19a-P4-26 (2016).
3) M. Nakamura and R. Matsubara: J. Photopolym. Sci. Technol. **27**, 307 (2014)