MIS-CELIV Carrier Mobility Measurement on Triphenylamine-Thienothiophene-Based Hole Transport Material with LiTFSI

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[Introduction] Recently, a hole transport material, 4,4'-(thieno[3,2-b]thiophene-2,5-diyl)bis(N,N-bis(4-methoxyphenyl) aniline) (TT-2,5-TPA) (Fig. 1) was developed and applied for hybrid perovskite solar cells[1]. The electronic properties of TT-2,5-TPA could be modified by blending a dopant, such as lithium bis(trifluoromethanesulfonyl)imide (LiTFSI), with considerable advantages to raise the charge carrier concentration[2]. In this paper, the carrier mobility of TT-2,5-TPA with LiTFSI regarding to temperature dependence was studied by metal-insulator-semiconductor charge extraction by the linearly increasing voltage (MIS-CELIV)[3] method.

[Experimental method] Device structure with TT-2,5-TPA film was composed for the MIS-CELIV measurement as shown in Fig. 2. The injected holes were accumulated near the interface of MgF_2/TT-2,5-TPA and extracted through the MoO_3/Au electrode by a sawtooth-wave applying a reversely-biased linearly-increasing voltage bias.

[Results and Discussion] The Arrhenius plots of the hole mobility in TT-2,5-TPA with LiTFSI doping concentration from 0 to 0.6 wt% are shown in Fig. 3. The activation energy (E_a) of the TT-2,5-TPA thin film with LiTFSI changed as a function of doping concentration, and was evaluated to be 115-26 meV[4]. The decrease of E_a can be interpreted that most of the localized carriers cause the thermal activation involved with the enhanced hopping rate owing to the LiTFSI doping.

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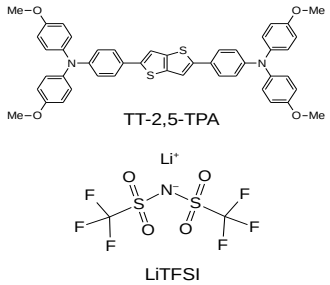

Fig. 1 Molecular structures of TT-2,5-TPA and LiTFSI.

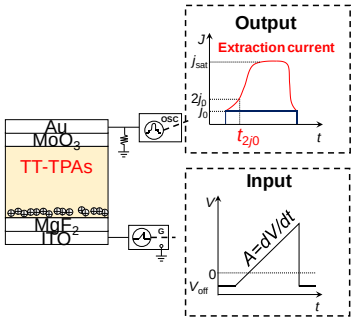

Fig. 2 Device structure and MIS-CELIV measurement system.

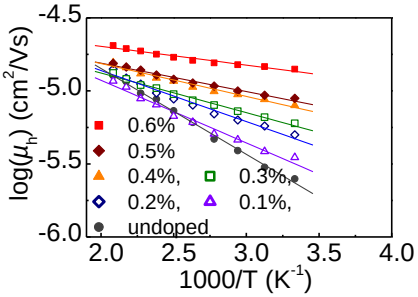

Fig. 3 Hole mobility of TT-2,5-TPA with LiTFSI as a function of doping concentration.