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Determination of Carrier Mobility in MEH-PPV by Time-of-Flight, Dark Injection SCLC and Charge Extraction in a Linearly Increasing Voltage (CELIV) techniques.

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Abstract – This work presents the results of mobility measurements for semiconductor poly[2-methoxy, 5-(2'- ethyl-hexyloxy)-1,4-phenylene vinylene] (MEH-PPV), obtained through Time-of-Flight (ToF), Charge Extraction in a Linearly Increasing Voltage (CELIV), Dark Injection in Space Charge Limited Current (DI-SCLC) and current density versus voltage (J vs. V) techniques. These techniques are applied also for degradation studies of polymeric light-emitting diodes.

Polymeric semiconductors such as poly[2-methoxy, 5-(2'- ethyl-hexyloxy)-1,4-phenylene vinylene] (MEH-PPV) have been widely studied in the last years thanks to their electronic and optical properties suitable for applications on optoelectronic devices (e.g. Light-Emitting Diodes, LED) [1]. Despite their importance and all the acquired knowledge, charge transport mechanisms are still not fully understood. A detailed description of the states and charge carrier mobility requires many efforts due to the difficulty in conventional techniques such as Time-of-Flight (ToF) for studying thin-films as used for electronic applications [4-5]. In this context, we propose the application of a new and powerful technique, Charge Extraction in a Linearly Increasing Voltage (CELIV), to determine charge carrier mobility in structures where the active layer thickness is in the order of hundreds of nanometers. The validity of the results will be demonstrated by comparing them to more conventional techniques, such as ToF, Dark Injection in Space Charge Limited Current (DI-SCLC) and current density versus voltage (J vs. V) measurements, reaching the minimum thickness where other techniques fail to work. Results from CELIV measurements applied to PLEDs degradation studies by observing changes in carrier mobility and charge injection on samples exposed to air and encapsulated will be shown.

Samples are processed on indium tin oxide (ITO)-coated glass substrates (Fig. 1-A). Prior to organic thin-film deposition by casting or spin coating, ITO is etched in chloridric acid and cleaned under standard solvents. Poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate) (PEDOT:PSS) is spun at 3000 rpm and dried in vacuum at 120ºC. After stirring the semiconductor solution for days prior to deposition, MEH:PPV in chloroform is deposited and dried at 55ºC. Samples are then loaded into a thermal evaporator for aluminum (Al) deposition. Encapsulation is done inside a glove box in argon inert atmosphere with epoxy and glass. Previous results are shown in Fig. 1-B.

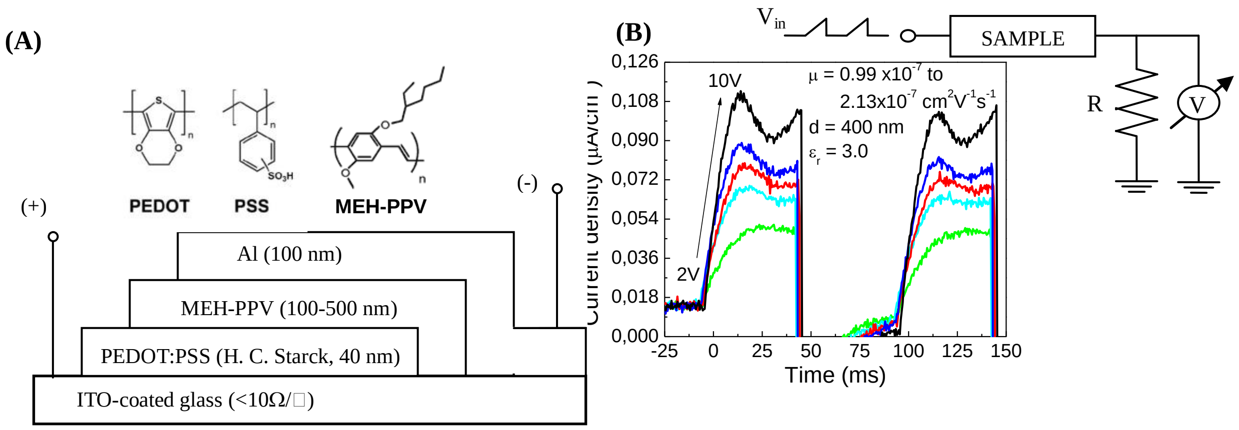

Figure 1: (A) Sample structure and organic materials employed. **(B)** Typical response and circuit of CELIV

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