Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Organic semiconductors with a charge carrier life time of over 2 hours at room temperature.

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S1. Depositing of Al_2O_3 film

Coatings were fabricated by first coating the ITO Teer Coatings UDP 650 closed field unbalanced magnetron-assisted physical vapour deposition (PVD) system of base pressure <3x10-5 Torr. A 57 mm diameter Al_2O_3 target was sputtered using Ar as a working gas at ca. 2 x10^{-3} Torr and 41 sccm. The RF power applied to the target was 100W for a period of 4 hwith an applied negative bias on the substrate of -25 V.

S2. Experimentally determining the permittivity of the insulators

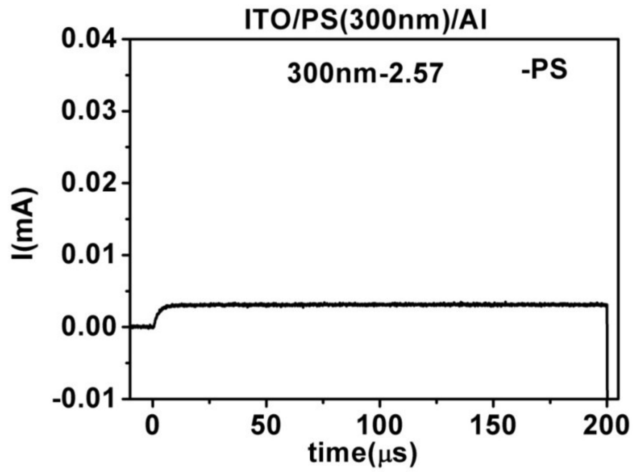

Figure S1: Current transient for a ITO/PS/Al device.

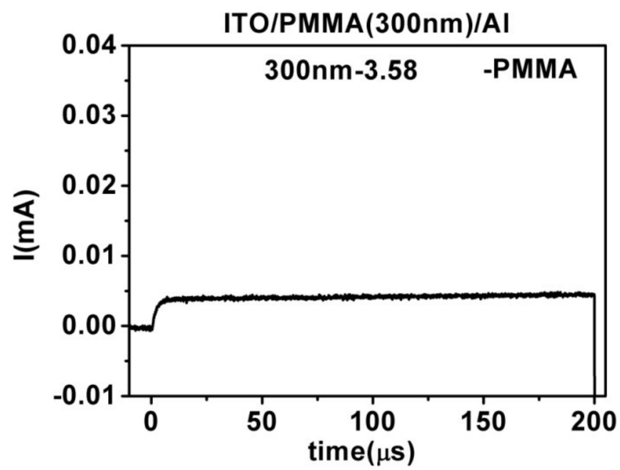

Figure S2: Current transient for a ITO/PMMA/Al device.

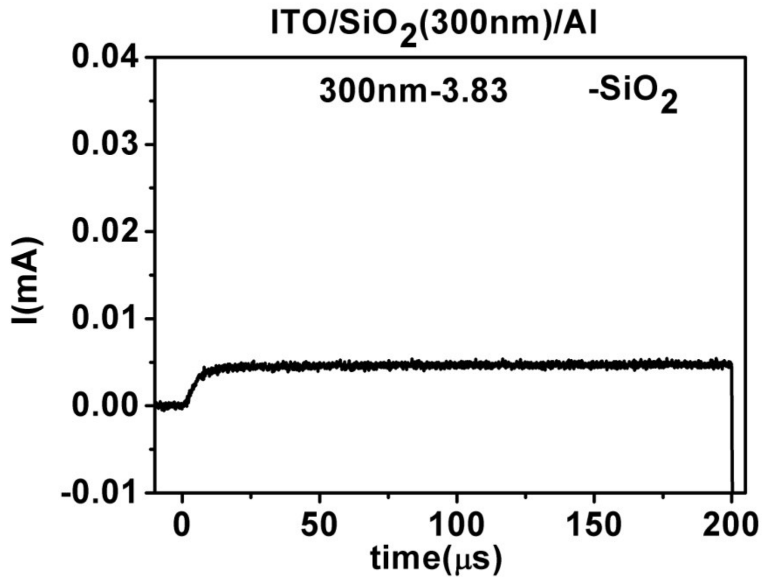

Figure S3: Current transient for a ITO/SiO_2/Al device.

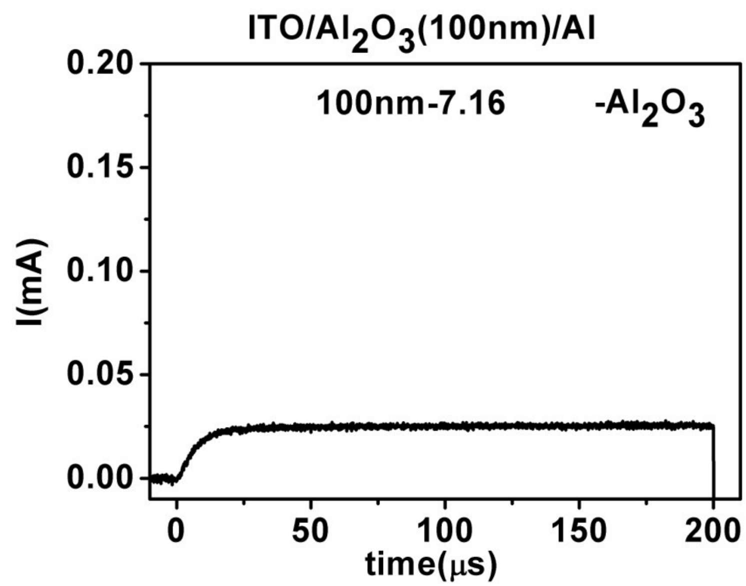

Figure S4: Current transient for a ITO/Al_2O_3/Al device.

S3. Encapsulating and not encapsulating the device

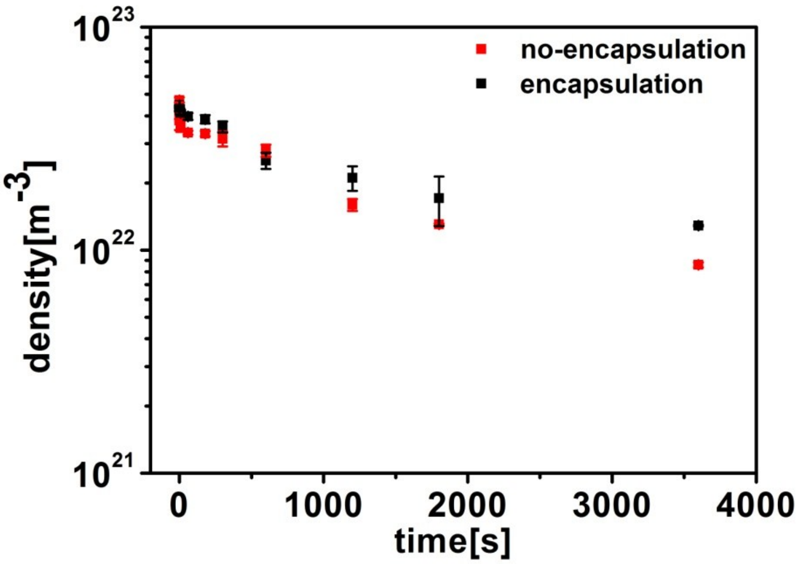

Figure S5: Influence of not-encapsulated (red) and encapsulated (black) the device on charge carrier life time.

S4. Full transients from different semiconductors

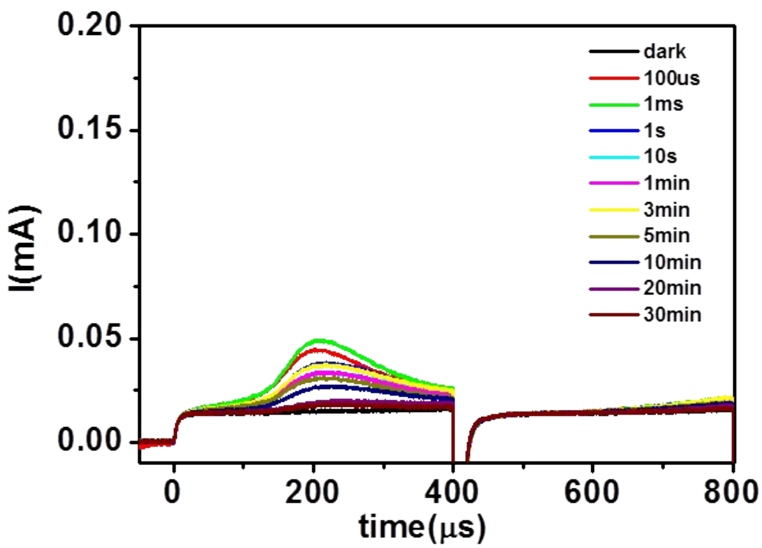

Figure S6: ITO/SiO2(100nm)/Spiro-OMeTAD(100nm)/Al

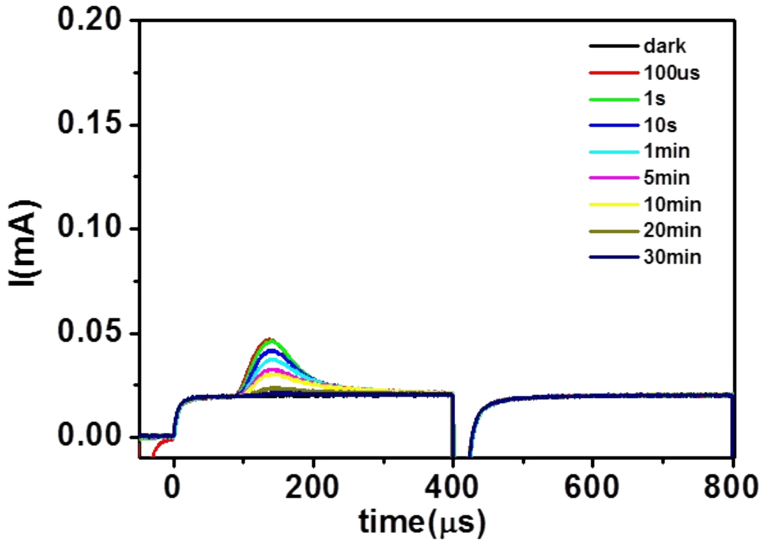

Figure S7: ITO/SiO2(100nm)/TAPC(100nm)/Al

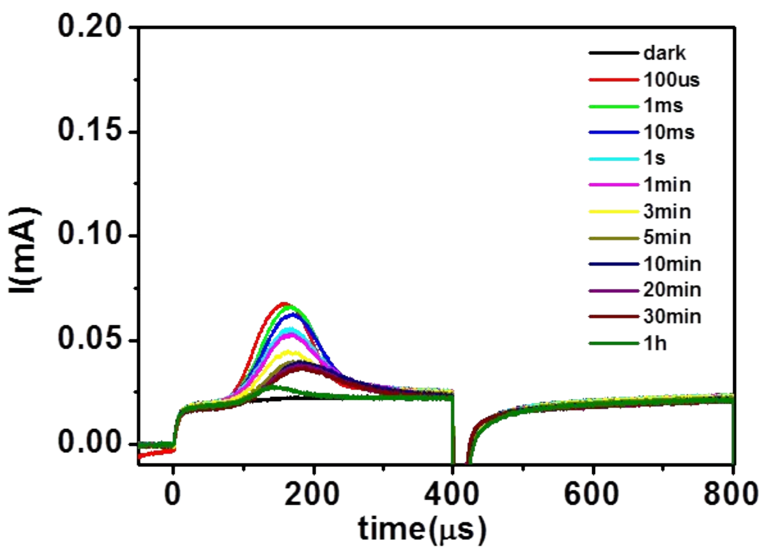

Figure S8: ITO/SiO2(100nm)/TPD(100nm)/Al

S4. Modeling

A free copy of the model used to perform the simulations in this paper (figure 7b) can be downloaded at www.opvdm.com. The model is a drift diffusion model which describes recombination using a SRH formalism.

S5. Doping in organic semiconductors

In classical inorganic electronics, one would say a material is pure and undoped if it had a purity of 99.9999999% (or nine nines purity). The atomic density of silicon is around $5x10^{28}$ atoms/m^3, this means in nominally undoped silicon there are $5x10^{19}$ dopant atoms per m^3. In contrast, a highly doped inorganic semiconductor has around $1x10^{25}$ dopant atoms per m^3. If one now considers organic semiconductors, a material is considered 'pure' if it has a purity of only 99.9%. If we use fullerene for this example, and assume it is a square box with the volume of 1nm * 1nm * 1nm it will have a density of $1x10^{27}$ molecules per m^3, if we then assume it is 99.9% pure, we can then calculate that it has a dopant density of $1x10^{24}$ atoms per m^3. Thus from these simple calculations, it can be seen that even a 'pure' organic semiconductor is doped almost as much as a highly doped inorganic semiconductor. This simply highlights how contaminated organic semiconductors are when viewed from the inorganic semiconductor stand point and this is the reason why all organic semiconductors studied produced long life times when placed in our device structure.