Synthesis, characterization, photovoltaic performances and stability analysis of new NFA molecules with an extended pi-conjugated core

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In the past few decades Organic Solar Cells (OSC) have emerged as one of the promising third generation photovoltaic technology on account of their advantages like light-weight, flexibility, transparency and potential low cost1. Until 2012, the scientific community has made considerable efforts on the development of new donor materials combined with fullerenes. Despite the development of hundreds of new p-type materials, the efficiency of OSC have not become potentially competitive until the rise of non-fullerenes acceptors, which have overcome some of the technical drawbacks associated to the fullerenes. Using them, the photovoltaic performance have been increased up to 16%2 in single junction and over 17%3 in tandem solar cells. Although, it must be remembered not only a high efficiency is required but high stability to make OSC technology viable for commercialization. Thus, more in-depth study are needed to further understand degradation mechanisms.

In that context, we present the synthesis, the characterization and the use in OSCs of three new NFAs with extended π-conjugated segments between the acceptor moieties. Some of them contain fluorine atoms in the acceptor units, which has been proved to play a role on the photovoltaic performance4. These NFAs have been combined with the PCE12 donor polymer obtaining, as preliminary results, power conversion efficiency comprise 5-6% with an outstanding Voc over 1,1V, significantly higher compared with ITIC-based devices used as a reference in this work. The NFAs have been exposed under thermal and photochemical stress. Noticeably, one of the, exhibited improved stability compared with ITIC.

Figure 1: Normalized absorption spectra of the new NFAs (left) and structure of the new NFAs (right)