Synthesis and characterization of different type of Polymers as a potential HTM for Perovskite solar cell

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Synthesis of dopant-free polymers for perovskite solar cells

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The increasing world energy demand makes compulsory the search of energy sources alternative to fossil fuels. Among alternative energy sources, the solar energy is green, renewable and not exhaustible. Perovskite Solar Cells (PSC), which rose in efficiency from the 3.2% (2012) to 22-23% in only 5-6 years [1], are the new frontier of the photovoltaic research. The perovskite crystals are the core of the device, giving easy charge separation and high charge mobility. The two sides of the perovskite layer are covered with an Electron Transport Material (e.g. TiO_2, n-doped semiconductors…) and a Hole Transport Material whose goal is to drain charges efficiently. Unfortunately, perovskites show instability towards moisture, which rapidly deteriorates the device performances.
Most HTMs need to be doped to show good conductivity levels, useful for PSC cells, but doping agents are detrimental for cell stability since they are hygroscopic. The use of polymeric HTMs layers on one perovskite side seems to overcome those problems, granting a good stability increase, since the optimal filming properties of hydrophobic polymers.
Our interest was captured by polymeric HTMs showing an inherent high conductivity, the "dopant-free" conductive polymers [2] which appeared recently in the literature. Some structural aspects enhance the conductivity of organic molecules. In particular, when the donor (D) and acceptor (A) moieties can be alternated, the dipoles created along the conjugated polymeric chain increase the molecular conductivity. We prepared two kind of polymers whose synthetic routes are reported in Fig. 1 and 2. The first is a donor-acceptor (D-A) polymer based on a terthiophene monomer (**1**) and the second is a polytriarylamine based on the phenothiazine, as a linker. Some initial characterization and activity in perovskite solar cells are reported.

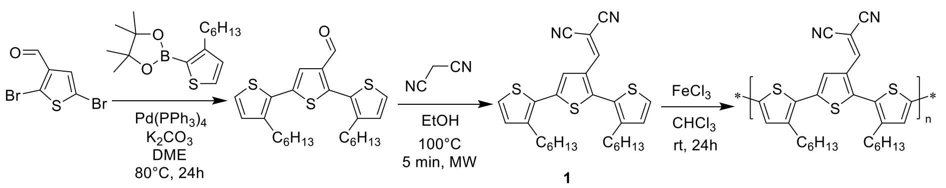

Figure 1: Synthesis of a donor-acceptor conductive polymer.

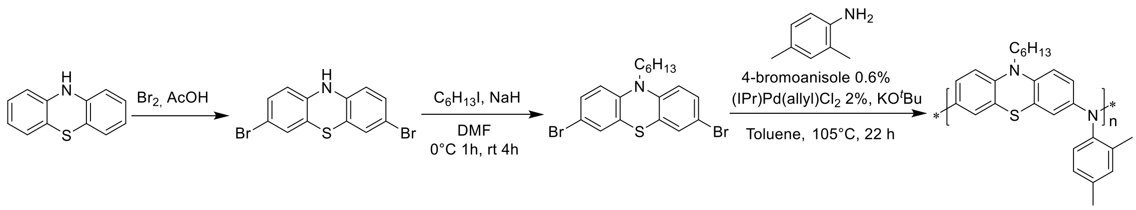

Figure 2: Synthesis of a phenothiazine-based polymer

[1] M. Green and A.Ho-Baillie, *ACS Lett.* 2, (2017) 822-830. [2] W. Zhou, Z. Wen, and P. Gao *Adv. Energy Mater.* (2018) 1702512.