Organic solar cells (OSCs) have attracted considerable interest in the last years due to their potential application in low-cost and large-area production. The typical structure of a BHJ-SC consists on a active layer that is a blend of $p$ and $n$ materials (as an example the well-known and most used polymer-fullerene blend P3HT:PCBM), sandwiched between two electrodes, a transparent conductive oxide (TCO) and an evaporated metal. Typically the TCO is indium tin oxide (ITO) which unfortunately presents serious issues related to i) the release of oxygen and indium into the organic layer, ii) the poor transparency in the blue region, iii) its stiffness, which prevents its use in flexible solar cells, and iv) the large cost due to the limited supply of indium. Several candidates have been reported to replace ITO, such as conductive films based on carbon nanotubes (CNT) or graphene. The limited thermal and chemical stability and the high surface roughness of CNT films, make this option less desirable. Recent studies report the electronic properties of graphene films, showing good conductivity and low sheet-resistance.

In this study, we report the fabrication of organic solar cells with a multi-layer graphene as semitransparent electrode. The multilayer graphene was grown by rapid thermal annealing on nickel films using a solid carbon source and transferred to glass substrates using a wet chemical transfer method. We chose the following architecture: graphene/Hole transporting Layer/poly(3-hexylthiophene) (P3HT) and phenyl-C60-butyric acid methyl ester (PCBM) active layer/Aluminum. Two different hole transporting layers have been considered, poly(3,4-ethylenedioxythiophene)/poly(styrene sulfonic acid) (PEDOT:PSS) deposited from solution and evaporated molibdenum trioxide (MoO3). The obtained devices have been characterized in terms of optical and electrical characteristics reaching a maximum efficiency of 1% with both HTL which was about one third of the efficiency achieved with the standard TCO based structure (~3%).

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