Abstract:

Among renewable energies, the sunlight has by far the highest theoretical potential to meet the worldwide need in energy. Photovoltaic devices are thus currently the subject of intense research for low-cost conversion of sunlight into electrical power. In particular, organic photovoltaics have emerged as an interesting alternative to produce electricity due to their low manufacturing cost compared to silicon solar cells, their mechanical flexibility and the versatility of the possible chemical structures. In this dissertation, we focused our research on the development of new organic π-conjugated materials for organic solar cells applications. Two types of solar cells have been studied during this work: bulk heterojunction and dye-sensitized solar cells. The charge transfer leading to the photocurrent is usually based on (i) a polymer donor and a fullerene acceptor in BHJ solar cells, such as the widely studied poly(3-hexylthiophene) (P3HT) and [6,6]-phenyl-C_{61}-butyric acid methyl ester (PC_{61}BM) materials and (ii) a metal oxide (titanium oxide) sensitized with a dye and an electrolyte in DSSCs. Despite power conversion efficiencies have reached 5 and 13 % respectively for these two types of devices, they still display several drawbacks that limit their commercialization. P3HT displays a narrow absorption of the solar spectrum thus limiting the power conversion efficiency. To overcome this limitation, we combined P3HT with chromophores, i.e. porphyrins, having an extended absorption. Then, to ensure better charge transfer and extraction within the device, a cathode interfacial layer based on cationic π-conjugated polyelectrolytes was added. Finally, dyes extracted from the biomass (chlorophyll derivatives) were synthesized to replace the expensive ruthenium dyes in DSSCs. Since liquid electrolytes are volatile and corrosive, which considerably limit the DSSCs stability, solid polymer electrolytes were also developed as an alternative.