Study and Development of Sustainable functional Organic Thermoelectric Materials for applications in Automotive

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*About 70% of the total energy consumed is wasted as heat, especially at low temperatures (<200 °C) [1,2]. It is therefore evident that collecting part of dissipated heat, and transforming it into electrical energy, is a crucial aspect to achieve for a more sustainable society. In this context, organic thermoelectric materials (**OTEs**) acquired significant interest toward the heat-to-electricity transformation [3]. In particular, polythiophene-based polymers, such as poly(3-hexylthiophene) (**P3HT**), have attracted considerable attention due to their solution processability, chemical and thermal stability, and high field-effect mobility [4]. Generally, to exhibit proper thermoelectric behaviour a material should have low thermal conductivity, high electrical conductivity and high Seebeck coefficient. Nevertheless, the increase of electrical conductivity is usually coupled with an increase of thermal conductivity and a decrease of Seebeck coefficient thus limiting the overall efficiency, at least in conventional inorganic materials [5]. Indeed, the electrical conductivity of organic conducting polymers such as **P3HT** can be finely modulated without a significant increase of thermal conductivity, which is intrinsically low. **P3HT** was synthesized by oxidative polymerization and optically, vibrationally, and thermally characterized. The electronic states tunability has been evidenced by doping the P3HT with anhydrous iron trichloride (**$FeCl_3$**) in acetonitrile at different molar concentrations and by detecting the formation of polarons via VIS-NIR and IR spectroscopy. Electrical resistance was measured, and it was found to decrease as the doping level increased. Afterwards, this material will be thermoelectrically characterized to figure out the optimum doping level to get a high performing thermoelectric material. In conclusion, polythiophene-based polymers are promising candidates to recover energy at low temperatures in different systems such as sensor networks, mobile devices, vehicles and buildings.*

Keywords: *low thermal energy harvesting, organic thermoelectric polymers, polythiophene-based polymers*

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