# Organic conductors under high magnetic fields

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Organic semiconducting materials exhibit electrical properties limited by the localization of the charge carriers. It is of paramount importance, in particular for applications in spin electronics, to increase the carriers mobility up to the emergence of delocalized transport, with expectations to reach metallicity. Studies of electrical properties at low temperatures under magnetic field are used to pinpoint such properties and provide better understanding of the underlying physics.

These studies will be applied to recently discoved methods to improve mobility and conductivity of thin organic films. The planned work will involve the realization of these devices and their extensive electrical characterization under cryogenic environment.

The first type of samples archtecture follows the recent discovery in Prof. Ebbesen' team in Strasbourg, showing how the mobility can be enhanced when carriers are coupled with resonance in an optical cavity [1]. The expected charge delocalization will be probed under magnetic field, providing unique insight when combining local and non local geometries. The related extraordinary long coherence length of the carriers are also ideally suited for spin electronics applications. One goal of this PhD will be to explore this revolutionay approach to organic electronics and test its applicability for spintronics.

The second type of samples rely on a high-mobiliy polymer synthesized by our collegues at the Chemistry Engineering School. First studies on thin films showed world-record conductivity values, reaching those of a metal. They were obtained by using an electrochemical doping technique recently developped in our team, capable of increasing the density of carriers, up to the signature of delocalized transport at low temperatures [2,3].

We propose to explore further the properties of these materials, in particular by taking advantage of our expertise in making appropriate modified magnetic electrodes to inject and detect spin currents [4]. We will also focus our efforts to nanoscale devices, where our first reults indicate remarkable changes of the interface properties, expected to play a dominant role at sub-micron lenght scale. For such purposes, nanoscale device architectures will be developped in the Institute cleanroom facilies.

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[2] S. Zanettini, J. F. Dayen, C. Etrillard, N. Leclerc, M. Venkata Kamalakar, and B. Doudin, **Appl. Phys. Lett. 106**, 0633303 (2015)

3] E. Lhuillier, J.-F. Dayen, D. O. Thomas, A. Robin, B. Doudin, and B. Dubertret, **Nano Lett. 15**, 1736-1742 (2015)

[4] T. Verduci, et al, **Adv. Mater. Interfaces** 3 1500501 (2016), patent application K. N0 2015-0133303, 21/09/2015