Conducting nanofibers from organic semiconductor polymers for thermoelectricity and electrochemical transistor applications

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In the past 20 years, organic semiconductors have emerged as interesting candidates for numerous optoelectronic applications. They find applications in the fields of display and lighting technologies (organic light emitting diode (OLED)), energy (organic photovoltaics (OPV), thermoelectrics (TE), hydrogen photocatalysis, etc…) and health (organic electrochemical transistor (OECT)-based sensors). In addition to a strong experience in nanofiber polymer processing by electrospinning (Figure 1),[1,2] the host team is highly skilled in organic conjugated polymer (CP) synthesis and characterization for TE application.[3] Recently, in collaboration with the institute Charles Sadron (ICS), it has been shown that combining controlled polar side chains and polymer alignment is an efficient route towards highly conducting polymer materials for TE application and OECT as well (Figure 1b).[4,5]

In this context, this multidisciplinary and collaborative PhD project aims to develop and study conducting nanofibers from organic semiconductor materials, for applications in TE and OECT. The scientific methodology will be divided in four main tasks:

1) Synthesis of conjugated polymers and modification of support polymers such as polysulfone (PSU) for fiber production.

2) Elaboration of aligned nanofibers following two strategies, either by co-axial electrospinning of PSU/CP or by solution-based CP coating of support electrospun aligned nanofibers.

3) Study of the effect of a thermomechanical post-treatment of the nanofibers on the CP crystalline structure and alignment.

4) Doping followed by structural and electrical characterizations.

The candidate should hence have excellent skills in organic synthesis and an open mind on polymer process and material characterizations. The candidate will be supervised by a strong interdisciplinary team and will benefit from a very high quality and internationally recognized collaborative network. A strong motivation for academic research is mandatory.

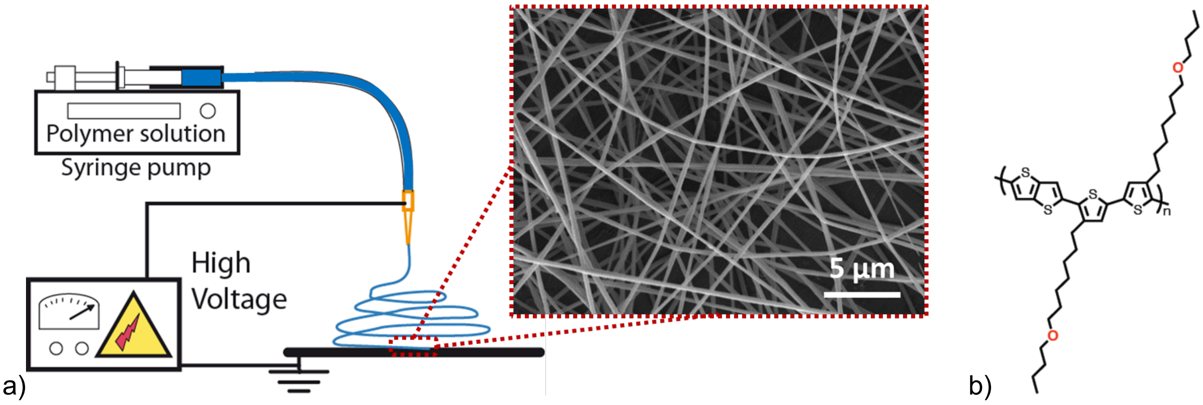

Figure 1. *a) Electrospinning setup and SEM picture of electrospun nanofibers. b) PBTTT single ether.*

[1] D. Mailley, A. Hébraud, G. Schlatter, *Macromol. Mater. Eng.*, **2021**, 306(7), 2100115.
[2] More information on: http://icpees.unistra.fr/en/polymer-engineering/electrospinning/
[3] V. Vijayakumar, Y. Zhong, V. Untilova, M. Bahri, L. Herrmann, L. Biniek, N. Leclerc, M. Brinkmann, *Adv. Energy Mater.*, **2019**, 1900266.
[4] P. Durand, H. Zeng, T. Biskup, V. Vijayakumar, V. Untilova, C. Kiefer, B. Heinrich, L. Herrmann, M. Brinkmann, N. Leclerc, *Advanced Energy Materials,* **2022**, 12, 2103049.
[5] Collaboration between the three following teams: M. Brinkmann (ICS), N. Leclerc (ICPEES) and N. Banerji (Bern university, Switzerland), communication in preparation.