China Scholarship Council / Université de Lyon Scholarships for doctoral mobility

Call for Thesis subjects for 2020/2021

RESEARCH SUBJECT TITLE:

Physical understanding of ionic motion in electrostrictive polymers: Improving performances of soft actuators

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Publication Website:

https://scholar.google.fr/citations?user=LIDE_voAAAAJ&hl=fr&oi=ao

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Doctoral School: Ecole *Doctorale MEGA* (ED 162) - Mécanique, énergétique, génie civil, acoustique

Lab Language: French/English

Minimum language level required:

- English: Fluent
- French: Basic (not mandatory)
- Other:

Abstract:

Flexible actuators based electroactive polymers (EAP) allow for the development of lightweight mechatronic functions that can be highly integrated into structures using additive manufacturing techniques [1-3]. Such materials are particularly suitable for shape control in various applications like medical field (steerable smart guidewire), astronomical field, (active shape control mirror) [4-6], and so on. Recent developments at LGEF (JF CAPSAL et al.) have demonstrated significantly improved electromechnical coupling of this new generation of EAP, with 6 to 10 fold increase in actuation ability, as opposed to the conventional polymers reported in literatures [7-8]. To the best of our knowledge, the developed process allows to achieve the most efficient electrostrictive material, however, its physico-chemical and fundamental understanding are still major issues [9]. The thesis subject therefore aims to identify the phenomena of nonlinear ionic transport in EAP as well as the interaction between plasticizer and constituent monomer. The ultimate goal is the intrinsic understanding of the plasticizer/matrix interaction, which is responsible for the exceptional enhancement in electroactive properties. At the end of the thesis, these profound comprehensions will lead the development of flexible actuators with highly improved properties that is adaptable to current additive manufacturing. This work will probably pave the way for ultra-high performance 4D printed systems [10].

The successful candidate must have a strong background in Materials Science and physico-chemistry of polymers as well as a solid experience on characterization techniques (ATG, DSC, BDS, XRD, MEB). Notions of in electrical properties of polymers and some understanding of additive manufacturing process would be also welcome. Finally, the PhD candidate will be able to adapt to different research specialties (mechanical, electrical engineering and so on) to work fast in order to be at the heart of technological breakdowns.

Expected duration of the thesis: 42 months.

References: **Name** (supervisors), Name (Former CSC PhD Students)

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8. N Della Schiava, MQ **Le**, J Galineau, F Domingues Dos Santos, PJ Cottinet, JF **Capsal**, Influence of Plasticizers on the Electromechanical Behavior of a P (VDF-TrFE-CTFE) Terpolymer: Toward a High Performance of Electrostrictive Blends, Journal of Polymer Science Part B: Polymer Physics 55 (4), 355-369
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10. D Grinberg, S Siddique, MQ **Le**, R Liang, JF **Capsal**, PJ Cottinet, 4D Printing based piezoelectric composite for medical applications, Journal of Polymer Science Part B: Polymer Physics 57 (2), 109-115