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PhD position: polymer chemistry and materials chemistry

Laboratory : European Membrane Institute (UMR5635 ENSCM / University of Montpellier / CNRS)

Department : Interface, Physicalchemistry, Polymers (IP2)

Group : Advanced Macromolecular Materials (MMA)

PhD supervisors: Claire Antonelli (MCF UM) and Damien Quémener (MCF UM, HDR)

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Tittle : Conception of polymers actuator to elaborate reconfigurable membranes in situ.

Summary of research project :

The objective is to prepare membranes able to adapt their intrinsic characteristics in operando thanks to the integration of polymeric actuators. Polymeric actuators are materials that change, in a reversible way, their shape and volume in response to an environmental modification **[1-3]**. The external stimuli of theses responsive polymers materials may be the temperature, mechanical or electrical stress, magnetic field, light (UV) and chemical exposure **[2,3]** (pH, solvent, moisture). The change in volume and/or in shape can be observed at nanometric scale as well as macroscopic level. The purpose of this PhD is thus to integrate polymeric actuators to the structure of a filtration membrane allowing its partial or total reconfiguration on request. As an example, a polymer actuator will be localise inside the membrane pores to control their number, size and shape (see figure). It will be also possible to localize actuators at the membrane surface to modify its roughness and thus enable changes in permeability (surface chemistry, contact chemistry) but also to facilitate unclogging operations. Finally, actuators will be integrated in the bulk membrane to study more significant structural configurations with the aim to elaborate stimulables nanomembranes.

Candidates should hold a Master degree in chemistry, polymer chemistry or materials chemistry or an equivalent diploma from a Chemistry School. CV, cover letter and reference(s) have to be sent to <u>claire.antonelli@umontpellier.fr</u> and <u>damien.quemener@umontpellier.fr</u> **before 22th may 2017**. Starting of thesis as soon as possible from November 2017.





Figure : Examples of membranes reconfiguration through actuator polymer stimulation

[1] L. Ionov. Polymeric Actuators. Langmuir, vol. 31, p. 5015–5024, 2015.

[2] M. Ma, L. Guo, D. G. Anderson, R. Langer. Bio-Inspired Polymer Composite Actuator and Generator Driven by Water Gradients. Science, vol. 339, p. 186-189, 2013.

[3] Q. Zhao, J.W.C. Dunlop, X. Qiu, F. Huang, Z. Zhang, J. Heyda, J. Dzubiella, M. Antonietti, J. Yuan. An instant multi-responsive porous polymer actuator driven by solvent molecule sorption. Nature Communications, 5 :4293, 2014.

