Structure and Dynamics of ***MIPEC***s (***M****ulticompartment* ***I****nter****P****oly****E****lectrolyte* ***C****omplexes)* of Dual Polarity

(PhD studentship jointly held between Technische Universität Berlin, Germany and the Institut Laue-Langevin, Grenoble)

Advances in modern polymer science allow to create evermore complex self-assembled structures [1], which are assembled by using electrostatic and hydrophobic forces. An example of such a system are multicompartment interpolyelectrolyte complexes (MIPECs, Fig. 1) which can be obtained by combining appropriate copolymers of opposite charge and which are stabilized by a hydrophilic corona [2]. These water-soluble colloids of 50-200 nm size combine different solubilisation properties, functionalities, and variable mesoscopic structure. This thesis will require first the synthesis of the copolymers, which are block copolymers and hydrophobically modified polyelectrolytes [3]. Afterwards we will address (i) the architecture of the hierarchical MIPECs and their solubilisation properties (cargo intake) and (ii) the dynamics of the nano-domains of different polarities, loaded and unloaded. Depending on time and progress of the project we will explore the kinetics of formation, cargo release and triggered disassembly. Thus this project shall lead to a comprehensive understanding of these self-assembled particles, for instance in order to optimize their use as drug delivery vehicles.

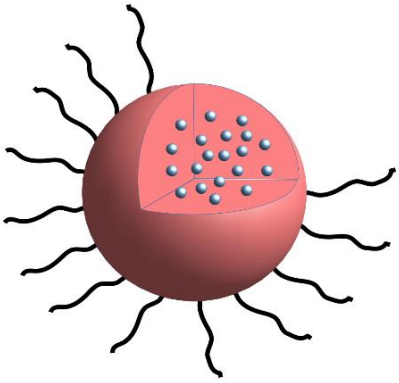

Fig. 1: *Scheme of a MIPEC with an IPEC core (red), small lipophilic domains (grey) and a nonionic corona (black)*

From an experimental point of view the MIPECs will primarily be studied by means of small angle neutron scattering (SANS) and quasielastic neutron scattering to characterise their structure and dynamics. This characterisation work is to be complemented by light scattering, ξ-potential and isothermal titration calorimetry (ITC) measurements to gain a comprehensive picture of the studied systems, with and without added solubilisate. Molecular Dynamics (MD) simulations will be carried out in parallel via a collaboration.

This work will be performed for one year at the TU Berlin and for two years at the ILL, where the TUB time could be either at the beginning of the thesis or during a long shut-down of the ILL. The PhD work will be supervised by Prof. M. Gradzielski (TU Berlin) in close cooperation with Drs. B. Farago and S. Prévost (ILL). Data analysis will be an important part of the PhD work and basic programming skills would be desirable. Neutron experiments will be carried out at ILL and/or other neutron sources. The PhD degree will be awarded by the TU Berlin. For this position we search a highly motivated student with a very good MSc/diploma in chemistry and physics (or a related field) and ideally some previous expertise in colloid/polymer science. This position will be funded for the two years in Grenoble according to ILL conditions (https://www.ill.eu/careers/working-at-the-ill/employment-conditions/) and for the one year in Berlin according to TUB standards.

For more information, please contact Prof. Dr. Michael Gradzielski (michael.gradzielski@tu-berlin.de) or Dr. Bela Farago (farago@ill.fr) or Dr. Sylvain Prévost (prevost@ill.fr). Applications including a motivation letter should be sent to one or all of the three contacts given with the reference “PhD project 191_24” in the subject.

[1] M. J. Webber, E. A. Appel, E. W. Meijer, R. Langer, Nature Materials 15, 2016, 13

[2] D.V. Pergushov, A.H.E. Müller, F.H. Schacher, Chem. Soc. Rev. 41, 2012, 6888

[3] S. Riemer, S. Prévost, M. Dzionara, M.-S. Appavou, R. Schweins, M. Gradzielski, Polymer 70, 2015, 194