Open PhD position at IMP (CNRS/Insa Lyon)

Polymer materials for hydrogen storage under high pressure

This PhD thesis belongs to the collaborative project (acronym HYperStock) of the French PEPR (Priority Research and Equipment Program) 'Decarbonated Hydrogen', aiming at accelerating the French Research Strategy. Massively decarbonizing mobility requires reducing the carbon impact of transport and storage solutions for compressed hydrogen, in the present case in high-pressure (so-called hyperbaric) tanks. A considerable challenge deals with the performances of the constituent materials, taking into account also their sourcing, processing and recyclability. For the polymer materials of the tank components, in particular the thermoplastic liner, the behavior under severe thermo-mechanical (pressure and heating due to cycling or rapid filling) and physico-chemical (H2 sorption) stresses must be controlled.

The general objective of the PhD will be twofold:

(1) microscopic damage mechanisms and their evolution kinetics under severe H2 environment (fatigue under H2 compression/decompression cycles) will be studied. The existing materials within current industrial solutions will be studied at this step. The methodology will consist in characterizing the materials in their initial state and after having been subjected to severe H2 environment (multiple H2 compression/decompression cycles, carried out by other project partners (CEA)). Microscopic damage will be characterized by monitoring the development of micro-cavities by small-angle X-ray scattering (SAXS/USAXS) and other techniques (X-ray tomography, electron microscopy). The evolution of the mechanical properties will be characterized for different conditions of severity and/or aging duration. Correlations between damage in an extreme H2 environment and the degradation of properties shall be established, in order to identifying the most critically impacted properties during fatigue, and therefore the most likely to limit the lifetime, taking into account the specific structure of the samples (crystallinity, texturing).

(2) an innovative solution will be proposed under the form of a bi-/multi-layer combining two complementary materials, which shall enable overcoming weak points in current industrial solutions and implementing new processing mehtods (extrusion /co-extrusion).

The laboratory 'Engineering of Polymer Materials' (IMP, CNRS/Insa Lyon UMR 5223) covers the entire field of polymer material science. It brings out original scientific questions from current societal challenges. Its strength lies in its ability to implement a multi-scale and multidisciplinary engineering approach derived from polymer chemistry and physics, in order to design polymer materials with controlled architectures, carrying combined functionalities and environment-friendly.

Candidates to this experimental PhD must have a master's degree in materials science, physics or physico-chemistry of polymers, and good ability to work in a collaborative context with partners with diverse profiles. To apply, send detailed CV and cover letter to:

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