Séminaire du laboratoire PIMM

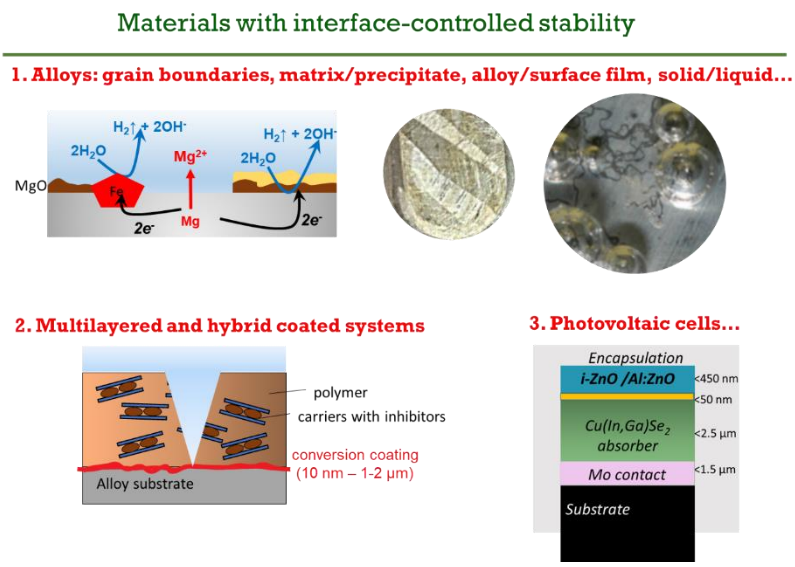
Jeudi 9 septembre 2021 à 13h30 en Amphi A

Dr. HDR Polina VOLOVITCH
Institut de Recherche Chimie Paris, CNRS, Chimie ParisTech, Paris

présentera dans le cadre du séminaire ses travaux intitulés :

Interface stability in multi-materials: from degradation to durability in presence of humid films

The importance of environmental stability is well accepted for structural metallic materials, for which the annual global cost of corrosion represents more than two trillion euros. Environmental stability considerations are however typically missing in the research of new functional materials, often non-metallic or/multi-material with numerous interfaces, and novel manufacturing processes. To produce long-term stable systems and elaborate an efficient knowledge based protection strategy, it is mandatory to identify possible degradation mechanisms of new materials and assemblies in specific environments. The presence of multiple interfaces (see examples in the illustration) makes this task non-trivial. Multiple elementary phenomena occur at different interfaces during environmental degradation in the presence of electrolytes or humid films. The most part of these interfaces is buried, the ex-situ failure analysis can be insufficient to define initial degradation mechanisms and select critical factors controlling degradation kinetics. A combined multi-disciplinary, multi-scale approach able to describe the evolution of chemical, electrochemical, mechanical state as a function of time in presence of evolving environments with good time and spatial resolution is necessary, requiring continuous improvement of existing and development of new analytical methodologies applied to these interfaces.



Some new analytical approaches to the problems of environmental durability of multi-material assemblies in the presence of electrolytes or humid films will be presented. This includes, from one side, model systems representing specific interfaces and development of accelerated degradation procedure able to mimic the degradation mechanisms representative for the mechanisms arriving in service. From the other side, it includes development of in situ chemical, electrochemical and visual characterization during degradation in order to verify the correlation of chemical modification and functional degradation, completed by 3D ex situ chemical characterization. Coupled methods include: Time Lapse Microscopy, Local Electrochemical Impedance Spectroscopy, in-situ ATR spectroscopy, in situ kinetic Raman Mapping, GD-OES, ToF SIMS and XPS.

The examples of application of the developed methodology to metal-oxide-polymer interface stability will be given. For instance, the role of the local thinning in 30 nm thick conversion coating under 10 µM epoxy resin on a rough electrodeposited metallic substrate is illustrated and it is demonstrated that the zone with local thinning of conversion coating on the rough substrates needs to reach some critical size to affect significantly the underpaint reactivity. Otherwise, the surface inhomogeneity related to the initial roughness hinders the effect of the local oxide thinning.