Postdoc position in electron microscopy:

Development of operando electron microscopy approaches for the study of texturing and structural modifications of porous materials

The determination of the structural and textural properties of porous materials is essential for the optimization of their properties of interest for use in applications, such as for example in heterogeneous catalysis as a catalyst support. These structural and morphological characteristics are transmitted through the processes of synthesis, shaping and post-synthetic modifications. Understanding these processes requires the in-situ monitoring of the systems of interest under conditions similar to those used in the synthesis and post-processing steps, at the scale of the basic structural entity which is a nanoparticle or a nanocrystal. These structures are ideally studied in real space in order to avoid having to rely on models and their assumptions, that become problematic when reaching the nanoscale. New approaches to study electron microscopy in environmental, gas or liquid mode are essential in this regard, but their implementation remains a challenge experimentally and must be adapted to the characteristics of the systems of interest and to the information sought.

The research project associated with this postdoctoral internship aims to develop methodologies for in-situ monitoring by in-situ environmental transmission electron microscopy of the evolution of porous materials during their synthesis or post-synthesis structural transformations. Two types of system will be the subject of these studies. The first concerns nanostructured alumina whose characteristics of the porous network of its low temperature polymorphs (γ-Al_2O_3 et δ-Al_2O_3) derive from the structure and texture of the initial boehmite gel; In-situ monitoring of the formation of the pore network by the aggregation of nanometric elementary crystallites and the agglomeration of the aggregates thus formed is therefore essential for understanding this nanostructuring process. The second is zeolite, the structural and chemical properties of which can be modulated by chemical and heat treatments applied once the zeolite crystals have been synthesized; the real-time observation of the genesis of porosity, in relation to the initial structure and the treatment conditions, will provide new information on the chronology and kinetics of the physicochemical processes involved in the targeted structural transformation. More particularly in electron microscopy, the challenges to be met are numerous, in particular the sensitivity of materials to electron irradiation, the observation of liquid phases in electron microscopy, the determination of the most suitable time scale, to name only the more obvious.

This work is part of the research activities of the CARMEN joint research laboratory and will take place at the IPCMS in Strasbourg with a few stays at IFPEN (Lyon). Once developed, the methodology will then be applied to the other systems studied in the four theses currently underway in the joint laboratory, for which in-situ studies represent the transversal subject between its various scientific axes.

Considerable experience in the use of electron microscopy techniques in material sciences is required. Experimental know-how in the implementation of experiments in environmental mode, gas or liquid, would be a real plus.

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Start : septembre 2021
Duration : 12 mois
Employer : CNRS
Raw starting salary : 2675 €