PhD position at IFP Energies nouvelles (IFPEN)
in Chemical sciences - Catalysis

Contribution of surface science to the development of hydrotreating catalysts: from the model solid on a planar surface to the actual catalyst

Hydrotreating catalysts are used in the refining of crude oil, to remove particularly sulfur containing molecules. They usually consist of supported molybdenum sulfides, whose activity is promoted by nickel or cobalt. The world market for hydrotreating catalysts (2nd largest catalysts market) is critical for the production of even cleaner transportation fuels. The improvement of these catalysts is, therefore, still a big issue for catalyst manufacturers. One of the factors that play a crucial role in the catalyst optimization is the interaction of the molybdenum and cobalt/nickel species with the support, usually a high surface area Al_2O_3. Depending on the morphology of the support, different crystal faces are exposed, which have each a specific surface chemistry in terms of density and nature of surface hydroxyl groups. In a recent work on single crystal aluminas, we have shown that the different crystal faces lead to radically different interactions with molybdenum species in the impregnation solution and also to a different behavior during sulfidation. Changing the morphology of the support, thus, provides an opportunity to fine-tune the properties of the sulfide catalyst.
In the present PhD subject we intend to carry on with this work, by extending it to promoted catalysts (CoMo and/or NiMo). The project includes the preparation of promoted catalysts on Al_2O_3 single crystals and their characterizations by surface science techniques. A catalytic test will also be developed to measure the catalytic activity of these model systems (which is not trivial because of their very small catalytic surface). Having identified the intrinsic catalytic activity of each crystal face, we will try to transpose the concept to real alumina supports, by synthesizing alumina crystals with the desired morphology. This last part will be carried out in collaboration with another IFPEN PhD project that is running in parallel.

Keywords: Hydrotreating, molybdenum, cobalt, nickel, sulfur, catalyst, surface science

Academic supervisor	Prof, CARRIER Xavier, Laboratoire de Réactivité de Surface (LRS) – Sorbonne Université UPMC, xavier.carrier@upmc.fr
Doctoral School	ED n°397, Physique et Chimie des Matériaux, http://www.ed397.upmc.fr/
IFPEN supervisor	Dr, DEVERS Elodie, Catalysis by Sulfides Departement, elodie.devers@ifpen.fr
PhD location	LRS, Paris, France and IFP Energies nouvelles, Lyon, France
Duration and start date	3 years, starting preferably on October 2, 2017
Employer	IFP Energies nouvelles, Rueil-Malmaison, France
Academic requirements	University Master degree in Physical or Chemical Science, Chemistry / Material Science
Language requirements	Fluency in French or English (C1), willingness to learn French
Other requirements	Heterogeneous catalysis recommended

For more information or to submit an application, see theses.ifpen.fr or contact the IFPEN supervisor.

About IFP Energies nouvelles
IFP Energies nouvelles is a French public-sector research, innovation and training center. Its mission is to develop efficient, economical, clean and sustainable technologies in the fields of energy, transport and the environment. For more information, see www.ifpen.fr.
IFPEN offers a stimulating research environment, with access to first in class laboratory infrastructures and computing facilities. IFPEN offers competitive salary and benefits packages. All PhD students have access to dedicated seminars and training sessions.