

Towards Earth-Abundant Nanocatalysts for Hydrogenation Reactions: Understanding the Promoting Role of Sulfur in Cobalt Phosphide Nanocatalysts

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We are looking for a PhD student for a joint research project of the Delley Group at the University of Basel (<https://delley.chemie.unibas.ch/en>) and the Operando Spectroscopy Group at the Paul Scherrer Institute (PSI, <https://www.psi.ch/en/operando>). The student will become a member of the Swiss Nanoscience Institute PhD school and will benefit from its strongly interdisciplinary environment, stimulating internal SNI events, and the personal support and training offered by the PhD program. The position will start as soon as possible after January 1, 2023. Please apply early, as the decision to fill the vacancy can be taken at any time in the process.

Project description Transition metal phosphides show promise as replacement of the typical (and non-sustainable) noble metal catalysts in chemical transformations and energy-related applications.^{1,2} Especially nano-sized phosphide particles have shown great prospects in this context, as they inherently possess large surface areas per mass. However, to achieve a practical implementation of transition metal phosphide nanocatalysts, their catalytic properties have to be understood and improved. In empirical studies, enhanced catalysis has sometimes been observed when a foreign element is incorporated in the catalytic material (e.g. by doping), especially with sulfur.^{1,3,4} Sulfur-doped phosphide nanoparticles could hence provide highly active and earth-abundant catalysts. However, the effect of sulfur in catalysis is currently not understood and can hence not be effectively used to rationally design and optimize new catalytic processes.

The goal of this PhD project is to develop an understanding of the role of sulfur in the catalysis of phosphides. In the proposed project we combine the expertise of the Delley group in surface chemistry and catalysis with that of the Operando Spectroscopy group in synchrotron-based spectroscopy and catalysis. Of key interest will be the development of structure-reactivity relationships of sulfur-doped phosphides through controlled nanoparticle synthesis, catalysis, and advanced X-ray based spectroscopy at the synchrotron.

We expect candidates for the position to have a Master degree in inorganic or physical chemistry or a related discipline, and ideally some experience in experimental inorganic chemistry, catalysis, and/or spectroscopy.

Applications should be made online at: phd.nanoscience.ch

For further information, contact Prof. Murielle Delley : murielle.delley@unibas.ch

¹ Shi & Zhang *Chem. Soc. Rev.* **2016**, *45*, 1529. ² Zhao & Yuan *Catal. Sci. Technol.* **2017**, *7*, 330. ³ El-Refaei et al. *ACS Catal.* **2016**, *6*, 8069. ⁴ Kibsgaard & Jaramillo *Angew. Chem. Int. Ed.* **2014**, *53*, 14433.