UNIVERSITY OF SILESIA
IN KATOWICE

PHD STUDENT IN THE DOCTORAL SCHOOL – CALL FOR APPLICATIONS

Position: PhD student in the discipline of chemical sciences
Unit of the project realization: Faculty of Science and Technology – University of Silesia in Katowice
Unit realizing the PhD student education: Doctoral School at the University of Silesia in Katowice

The University of Silesia is seeking a candidate for a PhD project dedicated to investigating the thermodynamics of surface properties and related thermal effects to develop an innovative method of thermal energy storage. The desired candidate would have the ability to think creatively and understand basic physico-chemical principles.

The position is available with (*Thermodynamics in Action Team* at the University of Silesia, Poland). This innovative project will involve active collaboration.

Scope of work in the project:

- Investigation of surface properties of systems nonwetting liquid – porous materials, solid-liquid interface development under nanoconfinement.
- Study of the heat generation (thermal effects) upon intrusion-extrusion of different non-wetting liquids (water, aqueous solutions, liquid metals) into crystalline and amorphous nanoporous materials.

Research will be carried out in the frame of the project „*Molecular springs as a new method of compact thermal energy storage*", financed from National Science Centre (NCN; project number UMO-2018/31/B/ST8/00599) under the management of dr hab. Mirosław Chorążewski.

Duration of the scholarship: 30 months

Scholarship amount: 4500 PLN per month before taxes (about 1000 EUR).

Project description:
A system consisting of a porous material immersed in a non-wetting liquid, also called molecular spring, can be used for energy applications [1-4]. Thus, mechanical [1-4], thermal [2,3] and electrical [2] energy can be stored/restored in the form of solid/ liquid interfacial energy in the reversible cycle of intrusion/extrusion of the nonwetting liquid. Energy must be supplied to the system for penetration of the nonwetting liquid into the lyophobic pores (charging) and is released on spontaneous extrusion of the liquid from the pores (discharging). Despite growing interest in the properties of molecular springs, thermal effects of intrusion-extrusion are poorly explored even though they are essential for practical use and understanding of the operating mechanisms.

During her/his work PhD candidate will thoroughly investigate surface properties of systems nonwetting liquids – porous materials, heat generation (thermal effects) upon intrusion-extrusion of different non-wetting liquids (water, aqueous solutions, liquid metals) into crystalline and amorphous nanoporous materials. Experimental techniques will be applied to support theoretical findings. In particular, the candidate will use unique high-pressure, high-temperature calorimetry and tensiometer supported by classical characterization techniques such as XRD, SEM, TEM, FTIR, etc. Special attention will be given to the reversibility of the intrusion process, e.g. to the hysteresis phenomena in a cycle of a non-wetting liquid "forced intrusion – spontaneous extrusion" into-from nanopores. The project's final goal is to understand the mechanism behind thermal effects of intrusion-extrusion and maximize them for the benefit of new generation thermal energy storage applications.

References

1. Tinti, A., Giacomello, A., Grosu, Y., & Casciola, C. M. (2017). Intrusion and extrusion of water in hydrophobic nanopores. Proceedings of the National Academy of Sciences, 114(48), E10266-E10273.
2. Grosu, Y., Mierzwa, M., Eroshenko, V. A., Pawlus, S., Chorążewski, M., Nedelec, J. M., & Grolier, J. P. E. (2017). Mechanical, Thermal, and Electrical Energy Storage in a Single Working Body: Electrification and Thermal Effects upon Pressure-Induced Water Intrusion–Extrusion in Nanoporous Solids. ACS applied materials & interfaces, 9(8), 7044-7049.
3. Grosu, Y., Li, M., Peng, Y. L., Luo, D., Li, D., Faik, A., ... & Grolier, J. P. (2016). A highly stable nonhysteretic {Cu2 (tebpz) MOF+ water} molecular spring. ChemPhysChem, 17(21), 3359-3364.
4. Amabili, M., Grosu, Y., Giacomello, A., Meloni, S., Zaki, A., Bonilla, F., ... & Casciola, C. M. (2019). Pore Morphology Determines Spontaneous Liquid Extrusion from Nanopores. ACS nano, 13(2), 1728-1738.

Job functions:

- Perform quality research within the scope of the project.
- Publish the obtained results in high-impact journals.
- Present the obtained results at international conferences.
- Develop the project as seen fit with others.

Essential Qualification:

- Masters of Science or qualified equivalent in the chemistry or physical science or applied sciences.
- Strong academic record.
- History of participation in research projects.
- Strong verbal and written communication skills in English, with a desire to improve.

Desired Qualifications:

- A team player who can collaborate with other groups, technical centers, and industries.

- Basic knowledge in computation and programming will be considered an asset.
- Self-motivation and ability to work independently.

Required Documents:

1. Resume with information about previous studies/employment,
2. Copy of the M.A. degree
3. List of publications and conference presentations
4. Opinion of the Supervisor
5. Copies of other documents proving possession of required qualifications

Candidates should register in IRK system: https://irk.us.edu.pl/ (available in Polish and in English) and select „Doctoral School – admission to a grant".

Documents should be submitted by **April 26th 2021** to an e-mail: miroslaw.chorarzewski@us.edu.pl. If you have any questions, please contact the project manager at the above e-mail address before formally submitting your application.
The documentation submitted by the candidates will be evaluated by a committee chaired by the project manager. Recruitment will be conducted in accordance with the appropriate NCN regulations. Recruitment can be conducted in Polish or in English. The interview will take place on-line. The decision of the committee will be presented to candidates via e-mail.