Hazard assessment of metal-phenolic networks for environmentally safe metal recycling

Summary

The project focuses on providing a framework for a safe-and-sustainable-by-design (SSbD) approach for the metal-phenolic network (MPN)-coated nanoparticles (NPs) (MPN nanocomposites) in metal recycling from wastewater. The aim is to conduct a systematic hazard assessment of a battery of MPN nanocomposites with good metal adsorbing properties (following 3R principles, i.e., without using vertebrate animals), and, based on these data, identify characteristics of MPN nanocomposites for safe and effective applications. The project will contribute to a modern and environmentally responsible circular economy.

Research field:	Chemistry and biotechnology
Supervisor:	Monika Mortimer
Availability:	This position is available.
Offered by:	School of Science National Institute Of Chemical Physics And Biophysics
Application deadline:	Applications are accepted between October 01, 2024 00:00 and October 25, 2024 23:59 (Europe/Zurich)

Description

There is a high demand for developing advanced technologies in the present day of transitioning from a traditional linear to a modern and environmentally responsible circular economy. New methods and remediating agents are needed for the efficient removal of contaminants and the cost-effective recycling of chemicals such as metals. A novel class of sorbent materials that are composed of plant-based chelators – polyphenols, and metals, coordinated with polyphenolic linkers, are promising in metal adsorption and recovery due to extraordinarily high surface area, tunable pore size, and adjustable surface properties. Specifically, the current project will focus on nanosized MPNs, which possess large specific surface areas to allow for effective metal adsorption. However, the design and synthesis of MPNs should follow a safe-and-sustainable-by-design (SSbD) approach for improved biocompatibility of nanosized MPNs.

The goals of the PhD project are to:

- Conduct toxicity testing of a battery of MPN nanocomposites following an exposure scenario-based approach (i.e., using organisms that do not internalize particles such as bacteria and algae; organisms that ingest (phagocytose) particles such as protozoa; and mammalian intestinal and lung cells to mimic ingestion or inhalation of NPs);
- Elucidate underlying mechanisms of bioactivity of MPN nanocomposites;
- Contribute to formulating design strategies for the synthesis of effective metal-adsorbing MPNs with favorable biocompatibility.

Responsibilities and (foreseen) tasks

- Conduct toxicity testing with bacteria, protozoa, algae, and mammalian cell lines;
- Assessment of viability, growth inhibition, and sub-lethal toxicity markers (e.g., oxidative stress and expression of proinflammatory mediators);
- Assessment of toxicity mechanisms using microscopic techniques, quantification of cell-associated metals, differential gene expression etc.;
- Based on toxicity data propose synthesis strategies for improving the biocompatibility of nanosized MPNs.

Applicants should fulfill the following requirements:

- A master’s degree in toxicology, biology, or related fields;
- A clear interest in the topic of the position;
- Ability to plan and conduct laboratory experiments and analyze the results;
- Excellent command of English;

- Strong and demonstrable writing and analytical skills;
- Capacity to work both as an independent researcher and as part of an international team;
- Capacity and willingness to assist in organizational tasks relevant to the project.

(The following experience is beneficial:)

- Experience with microbiology, environmental toxicity testing, and mammalian cell culture work;
- Experimental skills working with engineered nanomaterials;
- Working knowledge of statistics.

The candidate should submit a motivation letter explaining the interest in the topic of the position and the suitability of the candidate's experience, skills and background to the PhD project.

We offer:

- 4-year PhD position in an interdisciplinary research institute in Tallinn, Estonia;
- The chance to do high-level research in a research group with long-term expertise in nanomaterials and the environment;
- Opportunities for conference visits, research stays, and networking with leading experts in the field.

About the department

The National Institute of Chemical Physics and Biophysics (NICPB, Tallinn Estonia) is a public interdisciplinary research institute founded in 1979 (https://kbfi.ee/?lang=en). Basic and applied research is carried out in Chemical Physics, Chemical Biology, High Energy and Computational Physics, and Environmental Toxicology. The Laboratory of Environmental Toxicology at NICPB (https://kbfi.ee/environmental-toxicology/?lang=en) has longstanding expertise in the evaluation of pollution from the oil shale industry in Northeastern Estonia and assessing the safety and hazards of novel materials (specifically nanomaterials) to the aquatic biota and the environment. In addition to basic research, the laboratory conducts ISO and OECD standard toxicity testing and analytical chemical measurements. The laboratory adheres to the principles of 3R (Replacement, Reduction, and Refinement), and contributes to the aims of the EU's REACH policy.

For further information, please get in touch with Monika Mortimer, PhD (monika.mortimer@kbfi.ee).

To get more information or to apply online, visit https://taltech.glowbase.com/positions/854 or scan the the code on the left with your smartphone.