

Strategic design and synthesis of metal-phenolic networks for environmentally safe metal recycling

Summary

The project focuses on the design and synthesis of novel adsorbent materials – metal phenolic networks (MPNs) – with the main goal of developing safe and effective materials for metal recycling from wastewater. Following the principles of safe-and-sustainable-by-design (SSbD), a battery of MPNs on the nano-sized core will be synthesized, varying the nanoparticle core and the metal and phenolic components of the MPN coating. The design of the MPNs will be guided by toxicity data to improve the environmental safety of the novel materials. 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:	National Institute Of Chemical Physics And Biophysics
Application deadline:	Applications are accepted between October 02, 2023 00:00 and October 23, 2023 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 for the cost-effective recycling of chemicals such as metals. Ideally, an agent for highly efficient metal adsorption should be inexpensive, nontoxic, easy to synthesize and scale up, and able to capture a broad range of metal ions. 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 as these 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:

- synthesize a battery of MPN nanocomposites with good metal adsorbing properties
- based on hazard assessment data identify characteristics of MPNs that ensure environmental safety while maintaining the effective performance of the materials and
- formulate design strategies for the synthesis of effective metal-adsorbing MPNs with favorable biocompatibility

Responsibilities and (foreseen) tasks

- Adapt and optimize published protocols for the synthesis of nanosized MPNs
- Conduct physicochemical characterization of synthesized MPNs
- Characterize the metal adsorption efficiency of the synthesized MNP in different environmentally relevant conditions
- Based on toxicity data propose synthesis strategies for improving the biocompatibility of nanosized MPNs

Applicants should fulfil the following requirements:

- A master's degree in chemistry 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 provide assistance in organizational tasks relevant to the project

The following experience is beneficial:

- Experimental skills working with engineered nanomaterials
- Experience with chemical synthesis
- Working knowledge of characterization methods of 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 Institute

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 the areas of 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 long-standing 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 contact Monika Mortimer, PhD (monika.mortimer@kbfi.ee)



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