Silica-based Spheres Enriched with Sulfur- and Nitrogen-containing Groups: Transitioning from Adsorbents to Sensory Applications

Wednesday, 4th September - 11:30: Surfaces and interfaces - Oral

Mrs. Nataliia Stoliarchuk [1], Ms. Veronika Tomina [1], Dr. Viktoriia Kyshkarova [2], Dr. Iryna Furtat [3], Dr. Olha Semeshko [2], Prof. Gulaim Seisenbaeva [4], Dr. Inna Melnyk [2]

1. *Chuiko Institute of Surface Chemistry NASU,* ***2.*** *Institute of Geotechnics SAS,* ***3.*** *National University of Kyiv-Mohyla Academy,* ***4.*** *1 Department of Molecular Sciences, Swedish University of Agricultural Sciences, Box 7015 SE-75007 Uppsala, Sweden*

The chemical properties at the surface of silica-based materials play a pivotal role in their application effectiveness. The characteristics, positioning, and mixture of surface functional groups directly influence the adsorption properties of these materials. Through a singular synthesis process, it's possible to create functionalized silica spheres, paving the way for the development of sorbents that are highly efficient in cleaning wastewater from the metallurgy and textile industries or in the precise extraction of precious metals from discarded electronic components. In particular, the chemical makeup of silica surfaces can be customized to enhance their binding affinity towards specific pollutants, thereby optimizing their adsorption capacity. Therefore, the deliberate incorporation of specific functional groups, such as N- or S-containing groups, is intended to facilitate targeted interactions with pollutants. Additionally, the spherical shape of these materials contributes to effective mass transfer and the rapid establishment of equilibrium between the water phase and the adsorbent surface, further enhancing their overall efficiency.

Beyond their fundamental role in pollutant extraction from aquatic environments, these spherical entities demonstrate exceptional adaptability across a spectrum of applications. For instance, Cu-loaded silica particles endow these materials with antimicrobial properties, making them viable for integration into water decontamination frameworks. Moreover, modifying these entities with rhodamine 6G, fluorescein dye molecules, or rare earth elements transforms them into chemosensors capable of selectively identifying certain pharmaceuticals through photoluminescence detection techniques. Additionally, the application of silver nanoparticles onto the magnetic silica sphere exteriors enables their potential use as DNA probes for the detection of pathogenic microorganisms.

Thus, the distinctive attributes and customizable features of these functionalized silica constructs position them as formidable tools for addressing a broad array of scientific and technological challenges, underscoring their potential to drive advancements in various fields.

This work was supported by the APVV-19-0302, VEGA 2/0138/24, Štefan Schwarz Postdoc Fellowship No. 2023/OV1/016, the Recovery and Resilience Plan for Slovakia 09I03-03-V01-00098, 09I03-03-V04-00708 and HORIZON-MSCA-2022-SE-01 (CLEANWATER - 101131382) projects.