Hybrid organic-inorganic materials as functional adsorbents

,Elizabeth Polido Legaria,[a] Ievgen Pylypchuk,[a] and **Gulaim Seisenbaeva** [a,]

[a] Dept. of Molecular Sciences, Swed. Univ. of Agricultural Sciences (SLU), Uppsala, Sweden

Hybrid organic-inorganic nanostructured materials are highly requested in modern technologies exploiting them as functional adsorbents. The insight into the molecular aspects of ligand grafting and potential maximal capacity of hybrid organic–inorganic adsorbent nanostructures bearing ligand monolayers as active functions, allowed to produce adsorbents with high specific affinity towards target cations or specific molecules. Materials with bi- or multifunctional surface layers possess, undoubtedly, certain advantages over the materials with monofunctional coatings. Combining hydrophobic and hydrophilic groups, reveals opportunities for creating, for example, the patchy surface with hydrophobic walls and a hydrophilic center, influencing their sorption capacity [1] or catalytic properties. Introducing aminophosphonic [2] or aminocarboxylic [3] functions on the surface allows to create adsorption materials specific for certain metal cations. The principles for design of functional ligand monolayers have been developed using insight into coordination geometry of relevant molecular compounds [2, 3]. Tailoring of functional ligand layer facilitates further attachment of larger bio-catalyst molecules. Grafting of specific enzymes, hydrolases and oxidases, along with ligands capable to efficiently adsorb metal cations open for creation of multifunctional adsorbents, combining removal of hazardous metal cations with bio-catalytic action, destroying organic pollutants [4-6].

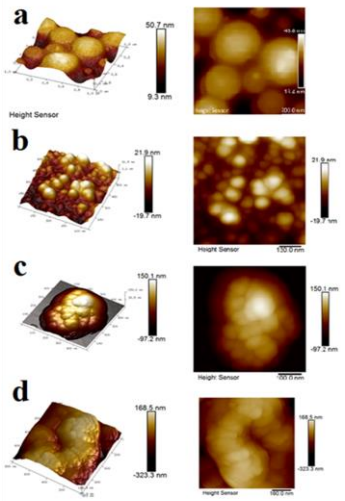

Figure 1. AFM images of native HRP (a), LiP (b) enzymes and sol gel encapsulated HRP (c) and LiP (d) composites

[1] Tomina V.V., Seisenbaeva G.A., et al., *Beilstein J. Nanotechnol*. **2017**, *8*, 334–347.
[2] Seisenbaeva G.A., Melnyk I.V., et al., *RSC Adv*., **2015**, *5*, 24575–24585.
[3] Polido Legaria E., Seisenbaeva G.A., et al., *Inorg. Chem*., **2017**, *56*, 13938−13948.
[4] Pogorilyi R.P., Seisenbaeva G.A., et al., *Colloids&Surfaces B: Biointerfaces*, **2016**, *144*, 135-142.
[5] Pylypchuk I., Seisenbaeva G.A., et al., *Nanomaterials*, **2017**, *7*, 298, 1-17.
[6] Pylypchuk I., Seisenbaeva G.A., et al., *ACS Sustain. Chem. Eng*., **2018,** *6*, 9979–9989.