

Layered minerals doped with iron nanoparticles showing reductive and magnetic properties for the removal and separation of selected inorganic ions

Description for the general public

Nanotechnology is now among the most intensively developing science field, due to the possibility of using the nanoscale objects in most areas of human activity. Therefore, it arouses the wide interest of researchers. This continuous development requires to search new or improving existing nanomaterials and nanocomposites. The nanocomposites, consist of at least two components, provided that at least one of them has a size in nanometer scale. In this project, the term nanocomposites refers to nanohybrid materials, which are consisted of mineral phases coated with iron nanoparticles. Such combination of these two components, can influence improving a particular properties of the starting minerals.

The iron nanoparticles seems to be one of perspective issue in the field of nanotechnology. These are sub-micrometer particles , that are highly reactive, due to their large surface area. Their additional advantage are also magnetic properties, that facilitate their separability. The proposed studies are focused on the possibility to synthesis nanohybrid composites, formed by coating mineral phases with iron nanoparticles. In the proposed project three layered structure minerals: natural halloysite and kaolinite, and synthetic hydrotalcite will be used.

The issue of iron nanohybrid composites has not been thoroughly investigate and understood until now. This limited knowledge concern particularly the possibility of using these composites as adsorbents, that means solid phases, which have ability to removal of contaminants from water. For these reasons the proposed research are concentrated on resulting nanocomposites adsorption properties determination, toward lead (Pb(II)), cadmium (Cd(II)), arsenic (As(V)) chromium (Cr(VI)), molybdenum (Mo(VI)) and selenium (Se(VI)).

To sum up, the scientific aims of research project are:

- Synthesis of nanohybrid composites, consisting of layered mineral phases coated with iron nanoparticles.
- Characterization of resulting iron-based nanocomposites.
- Determination the possibility and effectiveness of their application for metal ions removal, together with examination of possible mechanisms responsible for ions adsorption.
- Investigation on magnetic separation of the obtained nanocomposites from the liquid medium after ions removal.

The project involves interdisciplinary research combining the issues in the field of mineralogy, chemistry, nanotechnology and environmental protection. The chemical and analytical methods used in the project allows to thorough characterization of the nanocomposites and to understand the processes and mechanisms responsible for the removal of contaminants from water solutions. The project implementation will make a considerable contribution to our current knowledge con Investigation on magnetic separation of the obtained nanocomposites from the liquid medium after ions removal. Investigation of the regeneration and reuse possibilities for ions removal concerning nanotechnology of iron compounds, especially with regard to the nanocomposites utilization possibilities in water remediation and wastewater treatment, what is of environmental importance. The knowledge acquired through the implementation of the project can be useful for future research, in the field of iron nanoparticles. The obtained results will also help to indicate other possible directions of their use in environmental protection as well as in industry.