Hydrotalcite-like compounds (Htlcs), which are analogues of the naturally occurring mineral hydrotalcite, represent a unique class of lamellar materials built of positively charged hydroxide layers and interlayer filled with charge balancing, mobile anions A^{n-} and water molecules (Fig. 1). The divalent M^{2+} and trivalent M^{3+} metal cations occupy the centers of hydroxyl octahedra, connected to form infinite two-dimensional sheets. The compounds are characterized by an immense compositional variability, due to the large number of different M^{2+} and M^{3+} and a range of A^{n-} fitting into the Htlc structure. Htlcs find numerous applications as catalysts, photocatalysts, adsorbents, drugs and drug carriers, plastics fillers, etc. Of particular importance are nanostructured forms of Htlcs, with dimensions of particles below 100 nm, characterized by a high surface to volume ratio and well developed pore network, features highly desired in most applications.

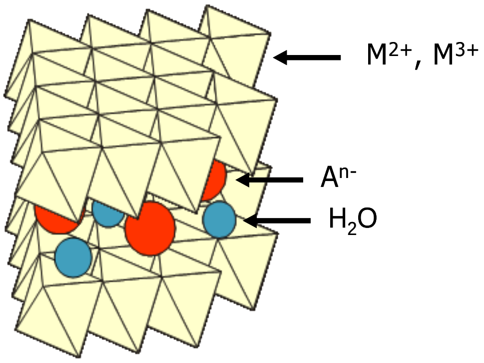

Fig. 1 Structure of a hydrotalcite-like compound

The project sets the frame for fundamental research into designing nanostructures of Htlcs, with aid of commonly available, cheap and environmentally friendly natural biopolymers such as starch or gelatin. In the proposed approach biopolymers are used in the capacity of soft structure-modeling templates, which assist in the formation of Htlcs nanoarchitecture and are removed after completion of the process. The use of biopolymers for Htlc nanostructures synthesis complies with the most recent trends in materials engineering and represents “green” alternative to the use of the more expensive, more complex and less eco-friendly procedures based on synthetic templating agents. The attractive features of natural substances are, beside their environmental compatibility, high abundance, low cost, renewable nature, and biodegradable character. Of particular importance is the multifunctionality of the employed biotemplates. Upon interaction with inorganic reagents used for HT synthesis they may: a) function as seeding nuclei, b) provide their three-dimensionnal network as structural scaffolding determining shape and size of nanoparticles, and c) in the case of template removal by combustion, act as fuel supplying extra heat enabling formation of highly crystalline oxide nanostructures. The novel materials will be designed for application as catalysts in two types of environmentally friendly processes: a) syntesis of ε-caprolactone, a monomer used for production of an important biodegradable polymer, and b) abatement of volatile organic pollutants. In the first case nanostructured catalysts with preserved Htlc structure will be used, in the other thermally decomposed oxide derivatives of nanostructured Htlcs combined with exfoliated layered silicates will serve in the capacity of the catalysts. It is expected that the tangible outcomes of the project will encompass development of innovative synthesis procedures for catalyst manufacturing, discovery of a new type of catalytic nanomaterials, and providing new input into the use of biopolymers in materials chemistry. It should be noted that the methodologies for materials syntheses to be developed are of general R&D interest, and applicable to any systems whose properties are dependent on the control of oxide or oxide-related material nanoarchitecture.