Development and characterization of solid apatite matrices capable of storing inorganic pollutants: structure and adsorption processes.

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Project goals

- Our project is based on a multidisciplinary approach involving physics, physical chemistry, mineralogy, microbiology, ecotoxicology and human toxicology. The project objectives are to highlight the major contributions in development of a new synthesis method for elaborating solid apatite matrices capable of retaining inorganic pollutants.

- The project aim is to develop scientific research on phosphocalcic apatite in order to exploit those phosphates that represent a form of natural wealth and to prepare a porous material, capable of effectively eliminating inorganic pollutants like heavy metals from contaminated soils and water.

- The main goal of this project is to put in place a new method of synthesis and elaborate solid apatitic matrices capable of retaining inorganic pollutants. Our studies will be focused on Pb^{2+} ions. The comparison between the adsorption properties of Pb^{2+} ions on the commercial apatite and the synthesized apatite represent another target of this project and also a novelty in the field.

Objectives

- The development and characterisation of phosphocalcic apatite and surface modification of calcium phosphate apatites in aqueous medium and characterization will be conducted. Porous hydroxyapatite will be prepared in aqueous medium at different reaction temperatures.

- Structural and morphological characterization of the nanoparticles will be performed.

- Evaluation of efficiency retention of Pb2+ and other metal compounds on porous hydroxyapatite

Tasks

The tasks are equally divided amongst partners as follows:

Romanian Laboratory

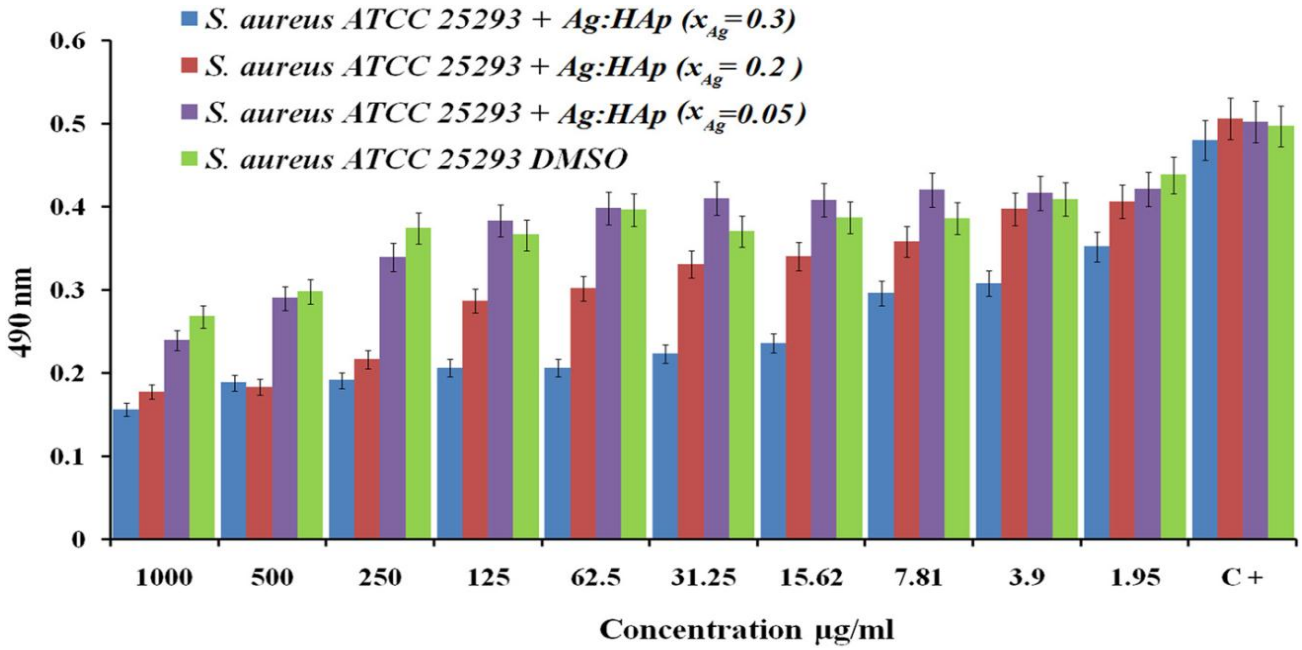
- X-ray diffraction (XRD),
- X-ray Photoelectron Spectroscopy (XPS),
- infrared spectroscopy (FT-IR),
- thermal analysis (ATG and ATD),
- determination of specific surface (BET method)

French Laboratory

- chemical and elemental analysis
- scanning electron microscopy (SEM),
- transmission electron microscopy (TEM),
- Raman spectroscopy,
- Atomic emission spectrometry (AES)

Results

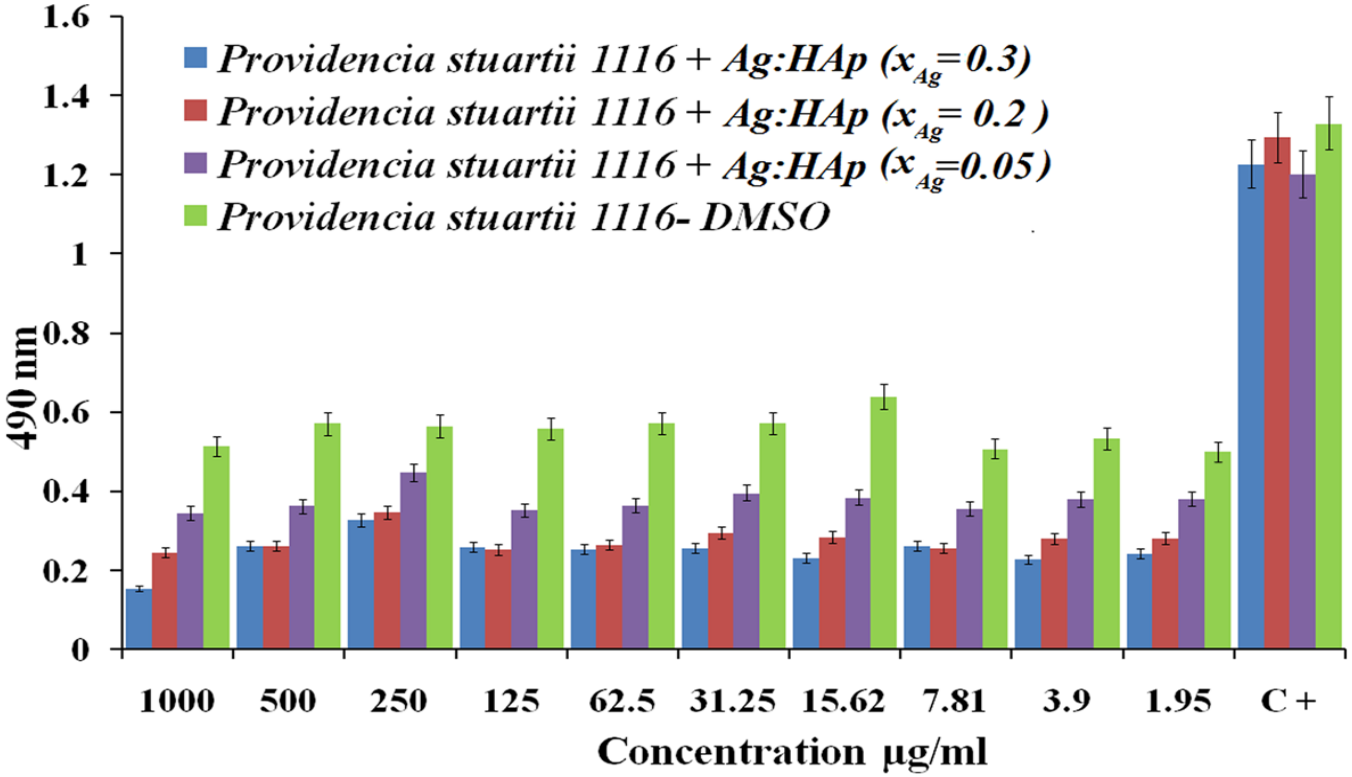
The Ag:HAp nanoparticles were evaluated for their antibacterial activity against gram-positive (Staphylococcus aureus) and gram-negative (Providencia stuartii) bacterial strains



Antibacterial activity of Ag:HAp-NPs (xAg = 0.05, 0.2, and 0.3) on S. aureus.

S. Aureus is still one of the five most common causes of nosocomial infections and is often the cause of postsurgical wound infections . S. aureus was inhibited for a **high** Ag:HAp-NP concentration. For the samples with **low** Ag concentration, no significant antibacterial activity was observed when the Ag:HAp-NP concentration was relatively low. In the samples with xAg = 0.3, no significant bacterial growth was observed.

Results



Antibacterial activity of Ag:HAp-NPs (xAg = 0.05, 0.2, and 0.3) on P. stuartii.

P. stuartii is commonly found in soil, water, and sewage. It is responsible for a number of significant opportunistic infections. The results of qualitative antibacterial tests revealed that the tested Ag:HAp-NPs had an important inhibitory activity on this microbial strain. The absorbance values of P. stuartii in the presence of Ag:HAp-NPs decreased compared with that of the organic solvent used (DMSO) for all the samples (xAg = 0.05, 0.2, and 0.3). Antibacterial activity increased with the increase of xAg in the samples. The Ag:HAp-NP concentration had little influence on bacterial growth (P. stuartii).

Results

In this short period (6 months) we have published :

- C. S. Ciobanu, S. L. Iconaru, P. Le Coustumer, L. V. Constantin, D. Predoi, **Nanoscale Research Letters**, Vol. 7, 2012, pp. 324

- C. S. Ciobanu, S. L. Iconaru, P. Le Coustumer, D. Predoi, **Journal of Spectroscopy**, Volume 2013, Article ID 471061, 5 pages, de.doi.org/10.1155/2013/471061

- S. L. Iconaru, A. M.Prodan, P. Le Coustumer, D.Predoi, **Journal of Chemistry**, Volume 2013, Article ID 412079, 6 pages, de.doi.org/10.1155/2013/412079

Common interests

- The formation of a new research staff specialized in new methods and techniques that will create the opportunity for approaching new research directions in the priority domain of environmental area.

- The young researchers from both countries will benefit from the expertise and facilities access to other parts of this partnership. Two or three doctoral theses will be conducted on the theme of the research project.

- The elaboration of a new synthesis method that enables obtaining of materials at low temperatures that can be used for immobilization and / or separation of organic and inorganic pollutants. On the other hand, the development of a new method of synthesis could lead to obtaining depolluted low cost materials that might be possible to be widely implemented.

- The project intends to create new jobs for students and young researchers.

Perspectives

- Both French and Romanian partners have well-established collaborations with research laboratories in the European Union and with industrial partners in the field of ceramic materials with applications in the environmental field.

- The results of the project can form the basis for further cooperation in international programs such as FP8.

Thank you for your kind attention