New magnetic/adsorbent systems for toxic cations in non-potable waters

Brief description

Given the basic need to have drinking water on our planet regardless of the area in which we live and to be able to contribute to environmental sustainability, the UCM research group on TECHNOLOGIES BASED ON INORGANIC AND ORGANIC HYBRID MATERIALS is working on the preparation of self-assembled systems and, specifically, magnetic-adsorbent nanoparticles for use in removing contaminating species from non-potable water.

Water is necessary for life on the planet, so the fact of being able to contribute to producing drinking water is a primary issue that is worthy of research.

How does it work?

The aim is to obtain samples with a core-shell nanostructure that incorporate oxide powder with superparamagnetic behaviour in their interior, which allows the nanostructure to be directed in search of contaminating cations.

Magnetic nanoparticles incorporate a surface coating that reduces their agglomeration and prevents their subsequent oxidation. Also, while the magnetic core facilitates a rapid separation, the coating can exhibit functional groups that exhibit a high affinity for toxic metals, thus increasing their adsorption potential. The outer layer must be made up of functional groups that exhibit a high affinity for toxic metal cations, thus increasing their adsorption potential in a specific and selective manner. Finally, these core-shell nanostructures will have to be removed using an external magnetic field.

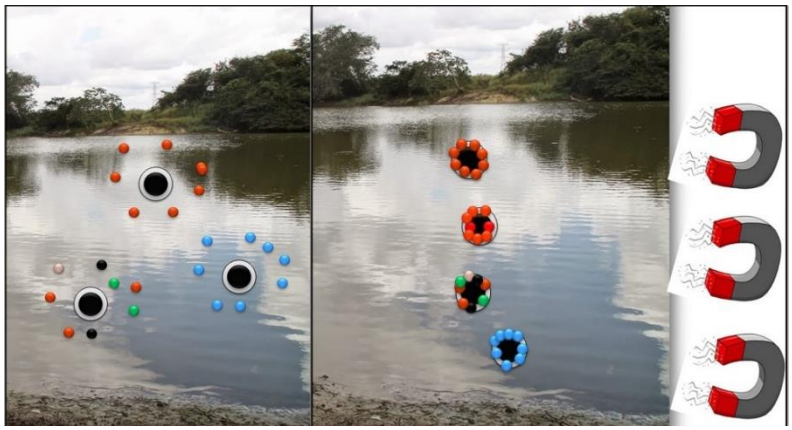

Figure 1. *Performance of systems based on magnetic-adsorbent nanoparticles*

What problem does it solve?

In most cases, water pollution is caused by toxic cations that are discharged into the aquatic environment through industries. Given the low biodegradability and the tendency to bioaccumulate these cations in water, these discharge processes pose a serious risk to the food chain by causing a variety of negative effects on human health after ingestion. And even if these metal cations are found in low concentrations.

Based on these potential risks, there is a growing global concern about the development of wastewater treatment technologies, including the testing of new synthesis methods, which allow the obtaining of nanostructures suitable for solving this type of problem. In this line of research, we carry out our research with the aim of obtaining new sorbents with high adsorption capacity, easy separation and recyclability to act in the preconcentration and subsequent removal of toxic cations.

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What future products will it develop?

As a result of the research carried out, samples of nanostructures with different organic and polymeric shells of great scientific and technological importance and use as sorbents with high adsorption capacity, easy separation and recyclability have been obtained. will be obtained for application in the paper industry.

Competitive advantages compared to another research

Over the years, different methods have been tested that have allowed the removal of heavy metal cations from wastewater. These methods include membrane separation, coagulation-flocculation, chemical precipitation, flotation, reverse osmosis, ion exchange, solvent extraction, adsorption, etc. Some of them have their own disadvantages such as low efficiency, sensitive work to environments and the production of toxic sludge. Others such as adsorption remain an attractive method due to their simplicity and high efficiency.

To date, different samples with different adsorbent capacities have been synthesized, although not many have proven to be useful for the removal of toxic cations. For this reason, obtaining sorbents with high adsorption capacity, easy separation and recyclability is a challenge today. To date, we observe that the results we have been obtaining with the development of our research significantly improve what exists until now.

Where has it been developed?

The UCM research group on TECHNOLOGIES BASED ON INORGANIC-ORGANIC HYBRID MATERIALS led by J. Isasi Marín, full Professor in the Department of Inorganic Chemistry, and M. Alcolea Palafox, full Professor in the Department of Physical Chemistry of the Faculty of Chemical Sciences of the UCM https://www.ucm.es/materialesaplicados/. María del Carmen Martínez Rincón, María Lourdes de Pedraza Velasco, María Paloma Posada Moreno, María Rapp Diez de la Cortina, Esther Hernán García and Luis Espada Morán are also members of the group. The first three are full Professors in the Department of Nursing of the Faculty of Nursing, Physiotherapy and Podiatry. The PhD students María Rapp Diez de la Cortina and Esther Hernán García are carrying out their doctoral thesis under the supervision of J. Isasi. Finally, Luis Espada Morán is a Computer Services Technician. Atos-CAU Department of Sciences.

And moreover…

The UCM research group on TECHNOLOGIES BASED ON INORGANIC-ORGANIC HYBRID MATERIALS maintains a direct relationship with the UAM since they have shared and continue to share research projects with D. Jaque Daniel Jaque García, University Professor in the area of Applied Physics at the Autonomous University of Madrid in the Department of Materials Physics, Director of the NanoBIG Research Group (Nanomaterials for Bioimaging Group).

Researcher in charge

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