**MOLDOVA STATE UNIVERSITY**
**INSTITUTE of CHEMISTRY**
**Laboratory of Ecological Chemistry**
**3, Academiei str., MD 2028,**
**Chisinau, Republic of Moldova**
***e-mail: lupascut@gmail.com***

HR EXCELLENCE IN RESEARCH

# NANOPOROUS AND NANOSTRUCTURED MATERIALS FOR MEDICAL APPLICATIONS (H2020 /734641 )

*Lupaşcu Tudor, Petuhov Oleg, Ţîmbaliuc Nina, Nastas Raisa, Lupaşcu Lucian, Gînsari Irina, Mitina Tatiana, Cibotaru Silvia*

**APPLICATION FIELDS**: Medicine – Health Care – Cosmetics; Environment – Pollution Control.

**AIM:** NanoMed project aimed to stimulate intersectoral and international collaboration within Europe and with third countries in the area of novel nanostructured adsorbents for the treatment of very serious health conditions associated with acute and chronic exposure to external radiation and uptake of heavy metals and radiation as a consequence of accidental, occupational and deliberate activation and events.

**PARTICIPATING COUNTRIES**: Spain, United Kingdom, Portugal, Greece, Hungary, Slovakia, Moldova, Ukraine, Kazakhstan

## THE MAIN ACHIEVEMENTS OF WP1:

• Activated carbon materials with a controlled porous structure and surface chemistry were prepared from a wide variety of precursors (rice husk, polymeric residues, petroleum residues, etc.)
• Pectins were successfully obtained from biomass residues (apple grape and beetroot).
• Natural and synthetic zeolites have been modified with Fe-based nanoparticles to infer magnetic properties.
• Synthesis conditions and post-synthesis methods have been designed to control the porous structure of the material and the surface chemistry.
• The most promising sorbents (based on the results from WP2) have been conformed into monoliths or pills for the final prototype testing.
• Additional porous materials have been considered in the project (e.g., metal-organic frameworks).

## THE MAIN ACHIEVEMENTS OF WP2:

• A round robin test using standard protocols for all partners was developed at the beginning of the project to unify the adsorption equipments. After the round robin all equipments within the consortium were properly certified.
• Samples synthesized in WP1 were properly characterized using a wide variety of techniques (gas adsorption, microscopy, etc.).
• The adsorption performance of the samples synthesized in WP1 (activated carbons, pectins, zeolites, MOFs, etc.) was evaluated towards cations and organic molecules (e.g., vitamin B12, bilirubin, proteins, etc.). These results emphasize their excellent performance, preferentially for activated carbons and pectins.
• Structural changes taking place upon adsorption were evaluated using a wide variety of techniques. These studies provided important insights about structural reorientation of the graphitic microdomains upon adsorption and the improvement in associated properties (e.g., conductivity).
• Conformed monoliths (combining activated carbons + pectins or zeolites + pectins) provided an excellent performance for the combined removal of cations and organic molecules due to the synergic effect between both components.

## THE MAIN ACHIEVEMENTS OF WP3:

• The best samples synthesized in WP1 and with the most promising performance in WP2 have been tested in the adsorption/retention of radical species in blood in animal models (e.g., rabbits) before and after irradiation.
• Although irradiation produces important alterations in critical blood levels (e.g., leucocytes, lymphocytes and thymus), the incorporation of the synthesized enterosorbents in the food allows to minimize these side effects due to the adsorption of radical species (superoxides) formed upon irradiation.
• Incorporation of enterosorbents in food allows to preserve the number of granulocytes, erythroid cells, and lymphocytes in blood after irradiation.
• Overall, the incorporation of enterosorbents based on activated carbon allows to mitigate the side effects produced after irradiation, the beneficial effect being more evident in the first hours after irradiation. The presence of a highly developed porous structure seems mandatory to achieve an optimum performance.

## IMPACT

NanoMed project has been an excellent platform for young students to learn about new fields (from synthesis of porous materials, to their characterization and application in biomedical processes), through the four workshops organized. These activities have been opened to the general public with a large participation of young students from the local institutions or institutions nearby.

The success in the project has been reflected in the formulation of final prototypes based on activated carbon + pectins or zeolite + pectins, with excellent results in the removal of ionic species and toxins in aqueous media. In the next steps after the project, the involved partners will evaluate the possibility to transfer these findings to the medical level and perform some medical trials to identify the performance in other animal models and/or in humans, as a last step of the process.
In summary, all the expected impacts within the NanoMed project have been properly addressed and succeed.

**IMPLEMENTATION STAGE:** implementation in local enterprises

**ACKNOWLEDGMENTS: This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreements 734641 NANOMED; This research was supported by the research projects: ANCD/20.80009.7007.21.**