

**UNIVERSITATEA BABEȘ-BOLYAI**  
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**ABSTRACT**

The habilitation thesis entitled "The impact of transition metal content on the synthesis and properties of nanostructured ferrites and on water quality assessment" synthetically presents my scientific and research activity after the defence of the doctoral thesis, and obtaining the scientific title of PhD in Chemistry, based on the Order of the Minister of Education, Research and Youth no. 1698 of 14.08.2009. The paper contains the results obtained in the field of synthesis, characterization and applications of nanostructured ferrites of divalent transition metals, physico-chemical evaluation of groundwater and surface water by calculation of pollution indices and mathematical modelling materialized in 122 scientific papers, of which 57 ISI-listed papers, 47 as lead author and a book chapter indexed Web of Science. The articles were published in 23 ISI listed journals. From didactic point of view, I have published 16 specialized books, of which 6 are unique authors and 7 are first authors.

The in-depth research directions developed during the postdoctoral period were grouped in two research directions.

The main direction in which I carried out my research activity is that of the synthesis of nanoparticles doped or undoped by  $\text{CoFe}_2\text{O}_4$ ,  $\text{MnFe}_2\text{O}_4$ ,  $\text{NiFe}_2\text{O}_4$ ,  $\text{ZnFe}_2\text{O}_4$ ,  $\text{CuFe}_2\text{O}_4$ , magnetic embedded in PVA using the original the sol-gel method, and their characterization by a wide range of methods as thermal analysis coupled with mass spectrometry, Fourier transform infrared (FT-IR) spectroscopy, X-ray diffraction (XRD), specific surface area analysis (BET), Mössbauer microscopy, inductively coupled plasma optical emission spectrometry (ICP-OES), scanning electron microscopy (SEM), EDX spectroscopy, transmission electron microscopy (TEM), atomic force microscopy (AFM), vibration sample magnetometry (VSM) and photocatalytic methods).

The secondary direction in which I carried out my research activity is that of the evaluation by GIS spatial distribution of the physico-chemical characteristics as well as the metal content of surface waters (lakes in protected areas), groundwaters, bottled waters, municipal water networks and their characterization by analytic methods (atomic absorption spectrometry, inductively coupled plasma mass spectrometry (ICP-MS), UV-VIS molecular spectrometry, colorimetric and turbidimetric analysis), calculation of water quality indices, pollution indices, evaluation of heavy metals, the degree of contamination and the evaluation of human risk, and finally the realization of the mathematical model.

The feasibility and originality of the studies were validated by the international scientific community, by accepting the publication of the results obtained in Web of Science journals.

The habilitation thesis includes three major chapters.

In **Chapter 1** they are presented the main professional, scientific and academic achievements in close connection with the field of chemistry obtained after defending the

doctoral thesis are briefly presented, as well as a selection of representative scientific results in:

- my activity of obtaining wide variety of nanostructured spinel ferrites by improving the synthesis methods, deepening the information obtained from a wide range of characterization methods and assessment of the nanomaterials potential use in coloristic, catalytic, photocatalytic, magnetic, dielectric, medical applications, water depollution and in the realization of sensors. The selection of synthesis methods ensures effective conditions toward an efficient control of purity, homogeneity, grain size distribution, porosity, morphology, phase composition, texture. The chemical and magnetic properties of ferrite are strongly influenced by the composition, structure and morphology of the particles, which are, in turn, dependent on the synthesis methodology. Hence the importance of developing new synthesis alternatives, by modifying the already known synthesis methods, will ensure the most advanced control regarding the shape and size of nanoparticles and, implicitly, their properties. The sol-gel method was used because it is the most versatile synthesis route, and allows the control of the stoichiometry of ferrites of transition metals and the production of homogeneous and crystalline nanoparticles of high purity under easy reaction conditions, coordination hetero-polynuclear synthesis compounds, new mechanisms are proposed and methods to obtain wide range of multifunctional ferrites with applications in chemistry, catalysis, pharmacology, ceramics, food industry.

- my activity regarding the development of a chemical model for the aquifer or groundwater or surface water resources, assessment of the quality of groundwater and surface water, environmental risk management and prevention of water pollution, impact assessment on human health, statistical evaluation of results and development of a mathematical model. The results obtained on drinking water contribute to the understanding of the complex way in which groundwater responds to the stress of anthropological activity, allowing recommendations for the population in order to prevent health risks and for sustainable practices. The main applicability is in environmental protection, by identifying various toxic metals in low or high concentrations in groundwater, which can have potential effects on human health, or for medical research, providing information on the concentration of each type of water, creating perspectives for future studies on the effects on human health and different organs or even the identification of some diseases. Another direction of major importance is to evaluate the quality of some water bodies located in the Rodna Mountains National Park, Romania, regarding various physico-chemical and biological characteristics, in identifying anthropogenic pressures (pasture and tourism) and implicitly in developing a series of measures to reduce negative anthropogenic influences and to determine the level of pollution, respectively to develop a new conservation rule for the biological and ecological diversity of lakes in order to use management tools for a sustainable use of water resources.

In **Chapter 2** are presents the planning of evolution and development of the teaching career, research and development of the academic career, respectively the main directions of future research.

In **Chapter 3** are presents the list of the 330 bibliographic references consulted.

Regarding the integration of science in the society, the research direction used provides a permanent contact with the fundamental research in the field of chemistry, with the researchers and teaching staff from the universities, in order to modernize the methods and the research techniques and to transfer and disseminate the obtained results.