

New Materials section (NMI)

INVITED PAPER:

“Advantages of simultaneous use of IS/DS spectroscopy analysis in the characterization of transport properties of ceramics and chalcogenide glasses”

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Abstract: Impedance spectroscopy (IS) is an established measurement method used for studying the electrical properties of a wide range of materials. The greatest advantage of this technique lies in collecting information about the materials' bulk phase (conductivity, dielectric permittivity) and their inner and outer interfaces simultaneously. Since it considers both the real and the imaginary part of the complex impedance, this approach is experimentally efficient and provides more information at the same time. Also, it enables the characterization of the electrical behavior of materials for which differently coupled processes contribute to their overall response. Namely, the electrical response of heterogeneous systems varies and depends on charge transfer, diffusion, and interface behaviors, which are difficult to analyze with traditional methods. In this sense, IS can be used to assess how charges are bounded or transferred by the creation of an equivalent electric circuit model, whose elements consistently represent the electrical properties of the material.

However, the low-frequency peak seen in several impedance spectra originates from the DC component of conductivity and therefore makes the real dielectric relaxation phenomena unable to be detected using this technique. Therefore, to conduct a comprehensive study about electrical inhomogeneity and carriers' behaviors in heterostructured materials combined impedance and dielectric spectroscopy analysis is frequently applied. DS study aims to determine the time constants using peak maxima, either from frequency dependence at a given temperature or from temperature variation at the selected frequency.

This paper presents relevant practical aspects of the interpretation and analysis of the electrical and dielectric behavior of three different classes of materials based on IS and DS modeling. The first class of materials refers to metal-doped chalcogenide glasses (Bi-As-S system and Cu-As-Se system) for which IS/DS analysis was crucial in the detection of different structural units and phases and characterization of their contribution to impedance response. The analysis of electrical and dielectric parameters of nickel ferrite nano-powders doped with yttrium revealed the contribution of both grains and grain boundary in conduction and relaxation processes. The effect of plasma treatment on self-cleaning features of acrylic paint/TiO₂-coated surfaces for environmental pollutant removal was also investigated by the means of IS/DS and this analysis was significant for confirmation of the contribution of oxygen vacancies.

Short biography:



PhD Mirjana Šiljegović is a lecturer at the University of Novi Sad, at the Department of Physics. At this moment she has published 34 scientific papers in the most prestigious international journals and has given several invited talks in the field of physical characterization of materials at related international and domestic conferences. She is the co-author of two books: Thermal and Mechanical Properties of Materials and Physics of Environment, both primarily intended for students of the Faculty of Sciences.

Her current research interests include the characterization of physical properties of amorphous and nanoscale low-dimensional materials with special emphasis on electric and dielectric investigations. She was a reviewer of more than 10 scientific papers from the same or similar scientific research area. She was a participant in several scientific and

research projects, first of all, national and provincial projects, and then international projects, financed within the Danube cooperation.