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SYNCHROTRON CRYSTALLOGRAPHY AND THE PHYSICAL PROPERTIES OF FUNCTIONAL POLYCRYSTALS

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Abstract

Various applications of synchrotron light to the investigation of the structure-properties relationship in polycrystalline functional materials are described. The first part of the presentation is devoted to structural analysis using various experiments with synchrotron light. High resolution diffraction experiments are shown to clarify crystal symmetry, two-dimensional diffraction measurements to characterize the texture of functional polycrystals, and x-ray absorption spectroscopy investigations to characterize short-range order and identify crystalline and amorphous minor compounds. In the second part, the way in which fine structural determinations explain and / or allow to predict tensor physical properties of single- and polycrystals is discussed. Attention is focused on the elasto-electromagnetic properties. The specificity of the single-crystal piezoelectric and magnetoelectric properties is discussed using arguments from group theory. The prediction of textured polycrystals' properties is considered. The adaptation of the Voigt, Reuss and Hill descriptions to the case of the above mentioned properties is presented. The open database "Material Properties Open Database" (MPOD, <http://mpod.cimav.edu.mx>) is presented and representative cases of the problems described are discussed.

About

Luis E. Fuentes-Cobas obtained his bachelor's, master's, and doctorate in solid state physics from the University of Havana (UH, Cuba). He developed a post-doc on neutronographic texture analysis at the Joint Institute for Nuclear Research Dubna (Russia). The academic interest of Dr. Fuentes-Cobas has been focused on the teaching and research of electromagnetism, the structural analysis of materials by means of synchrotron light and the structure-properties relationship in functional solids. His CIMAV Crystallography Group (mainly graduate students) has solved with synchrotron light the crystal structures of various piezoelectrics and multiferroics, created computer programs for the interpretation via modeling of two-dimensional diffractometric data and contributed novel algorithms for the prediction of the elasto-electro-magnetic properties of textured polycrystals. Dr. Fuentes-Cobas is coordinator of the international project "Material Properties Open Database (MPOD)", associated with the open database <http://mpod.cimav.edu.mx>, and of the scientific education project "Materials World Modules-México". He is the author or co-author of 150 articles and 7 books, has directed 40 graduate theses. He has received scientific awards in Russia and in Cuba. In 2012 he received the Chihuahua State Prize for Science, Technology and Innovation.

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