

NANOSTRUCTURED MATERIALS CHARACTERIZATION BY X-RAY DIFFRACTION

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Nowadays nano-technology, development, characterization, and applications of novel materials have become the main research focus of the worldwide engineering and research community. Particularly, semiconductor nano-structures have received growing interest due to their potential applications in electronic, opto-electronic and biological fields. The development of these new materials into future devices crucially depends on the development of new characterization techniques and theoretical models for the fundamental understanding of the relationship between the structure and properties. Since X-ray wavelengths are in the same order as the sizes of nano-structures, X-ray diffraction is an important characterization tool. X-ray diffractograms hold a wealth of structural information about the nano-materials. The micro- and nano-structure of materials is given by fundamental features, such as: (i) the crystallite size, (ii) size distribution, (iii) the defect structure/distribution, (iv) texture, (v) micro and macro strain, etc. The two principal tools for describing the microstructure of nano-structured materials are electron and X-ray probes. TEM and electron diffraction images provide local information about the primary nano-structure. X-ray diffraction provides complimentary information about the nano-structure by showing the average coherence length as a function of direction. X-ray diffraction results are averaged over a large volume giving an overall view of the nano-structure. This presentation will review the applications of X-ray diffraction techniques for determining nano-structure features of nano-materials, with examples applied for characterization of ZnO nano-wires.