PREFACE

The present research work reports the development of an innovative chemical method of the synthesis of a novel series of GMR materials of CrO_2 nanoparticles, Ag-metal surface stabilized CrO_2 of nanoparticles, and CrO_2-PVA polymer nanocomposites with an emphasis on a systematic study of their structural, microstructural, thermal, magnetic, electrical, GMR, and optical properties. The process involves an amorphous polymer precursor of a metal ion Cr^{4+}-PVA/ sucrose polymer complex formed in ambient air and pressure by a simple chemical reaction of a Cr(VI) compound, such as CrO_3, with reactive polymer molecules of PVA and sucrose in an aqueous medium. The basic premise lies in the fact that the Cr^{4+}-PVA/ sucrose polymer complexes capping in part of the PVA/sucrose polymer molecules are unable to encounter due thermal induced $Cr^{4+} \rightarrow Cr^{3+}$ transformation at such low pressure. A further surface modification by displacing part of the Cr^{4+} species by noble Ag atoms in a topotactic surface layer yields surface stabilized Ag:CrO_2 of nanoparticles. On heating the amorphous polymer complexes at selected temperatures, a controlled thermal decomposition and *in-situ* combustion of the decomposed species results in recrystallized CrO_2 (or Ag:CrO_2) of nanoparticles. The derived CrO_2 powders are explored to develop the CrO_2-PVA polymer nanocomposites of films. The silver coating the CrO_2 particles tunes the growth of such particles in form of thin fibrils in support over the polymer templates in the composite films. The formation of samples of selective compositions and their structural and other properties have been studied in terms of X-ray diffraction, thermal analysis, microstructure, XPS, IR spectra, optical absorption, photoluminescence, thermoluminescence, and EPR. Dielectric, electrical, magnetic and GMR properties have been studied for CrO_2 powder compacts and CrO_2-PVA polymer nanocomposite films.

The results and the data analyses are presented with discussion in five chapters. Chapter-I gives a general introduction about the subject with the statement of the problem, reviews of the chemical methods in synthesis of CrO_2 powders and thin films, their typical physical and electronic properties, and applications as potential optoelectronic and spintronic materials. Chapter-II describes experimental methods developed and followed in this study and the different analytical techniques applied to characterize the various samples. Analysis and modeling of the results are discussed in subsequent chapters of III to VII. A summary of the work with important implications achieved in this work is reproduced in the last Chapter-VIII along with the future scope of the work in this series.

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