Editor Note

Ferroics is the generic name given to the study of ferromagnets, ferroelectrics, and ferroelastics. The basis of this study is to understand the large changes in physical characteristics that occur over a very narrow temperature range. The changes in physical characteristics occur when phase transitions take place around some critical temperature value, normally denoted by Tc. Above this critical temperature, the crystal is in a nonferroic state and does not exhibit the physical characteristic of interest. In recent years, a new class of ferroic materials has been attracting increased interest. These multiferroics exhibit more than one ferroic property simultaneously in a single phase.

When I started my job as a Guest Editor with Trans Tech Publications Ltd. in 2011, I undertook publication of first volume under the title: "Ferroics and Multiferroics" which appeared in 2012. We could not cover all the envisaged topics under this Volume; hence we felt the need for the present volume: "Ferroic Materials: Synthesis and Applications". This Volume has ten Chapters, spread over areas as diverse as Magnetic Oxide Nanomaterials, Ferrites Synthesis, Hexaferrites, Spin Torque Nano-Oscillator, Ferroelectric Lattices, Flexoelectricity and Ferroelectric Materials for High Temperature Piezoelectric Applications.

Chapter 1 "Recent Advances in Synthesis, Properties and Applications of Magnetic Oxide Nanomaterials" tries to establish that oxide nanomaterials are in great demand due to their unique physical, chemical and structural properties. The nanostructured materials with desired magnetic properties are the future of power electronics. Unique magnetic properties and excellent biocompatibility of these materials found applications in pharmaceutical field also. For these applications, the synthesis of magnetic oxide nanomaterials with required properties is highly desirable. Chapter 2 deals with "Magnetic Properties of Mn-Zn Ferrites Synthesized by Microwave-Hydrothermal Process". The high values of permeability and saturation magnetization enable these materials to be the potential candidates for a number of applications, for example, in transformers, choke coils, noise filters and recording heads.

Next 2 Chapters focus on M-type and Y-type Hexaferrites, their synthesis and properties. Chapter 3 "Phase Evolution, Structural, and Magnetic Properties of Mo-Zn Doped M-type Hexaferrites" reports on the structural and magnetic properties of $BaFe_{12-4x}Mo_xZn_{3x}O_{19}$ hexaferrites with Mo-Zn substitution for Fe ions. Chapter 4 deals with "Effect of Non-ionic Surfactant" on "Microstructure, Magnetic and Dielectric Properties of Strontium-Copper Hexaferrite Powder".

The effect of surfactant concentration on phase formation, microstructure, magnetic and dielectric properties of Y-type strontium-copper hexaferrite has been investigated using XRD, SEM, TEM, VSM, dielectric and low field AC susceptibility measurement techniques.

Superparamagnetic Iron oxide nanoparticles (SPIONs) have fascinated researchers due to their vast applications in biomedical fields such as magnetic resonance imaging, cell sorting, hyperthermia, drug delivery, etc. Chapter 5 by Tokeer Ahmad and Ruby Phul describes hydrothermal synthesis, characterization and properties of SPIONs and establishes Magnetic Iron Oxide Nanoparticles as Contrast Agents. Chapter 6 presents a brief review of spin torque nano-oscillator, which has triggered extensive research interests in the field of nanomagnetism and applied spintronics in recent years. Potential applications of spin torque nano-oscillator in the fields of nanotechnology, computing, and biotechnology are highlighted by the authors.

Ferroelectric superlattices with polarization perpendicular to the surface or interface are studied within the framework of the Landau-Ginzburg theory in Chapter 7. Chapter 8 is based on “Structural, Electrical and Magnetic Properties of Ni doped Co-Zn Nanoferrites and their Application in Photo-catalytic Degradation of Methyl Orange Dye”. The experimental results could be explained using Neel's collinear two-sub-lattice model and three sub-lattice non-collinear model suggested by Yafet and Kittel.

Chapter 9 “Flexoelectricity in Bulk and Nanoscale Polar and Non-polar Dielectrics” is a unique contribution for this Volume. Flexoelectricity represents the polarization due to strain gradient and has significant effects on the functional properties of nanoscale materials, epitaxial thin films, one-dimensional structure with various shape and size, liquid crystals, polymers, nano-bio-hybrid materials, etc. The authors describe the basic mechanism of flexoelectricity, brief history of discovery, theoretical modelling and experimental procedures. In Chapter 10 “Ferroelectric Materials for High Temperature Piezoelectric Applications” world-wide R & D on HT piezoelectric materials has been reviewed. There is increasing commercial and technical interest for PE actuators (ranging from electronic muscles, fuel injectors and inkjet printers to various vibrators), PE sensors (pressure and other sensors and motion detection to energy recovery), and ultrasonic imaging devices.

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Editor