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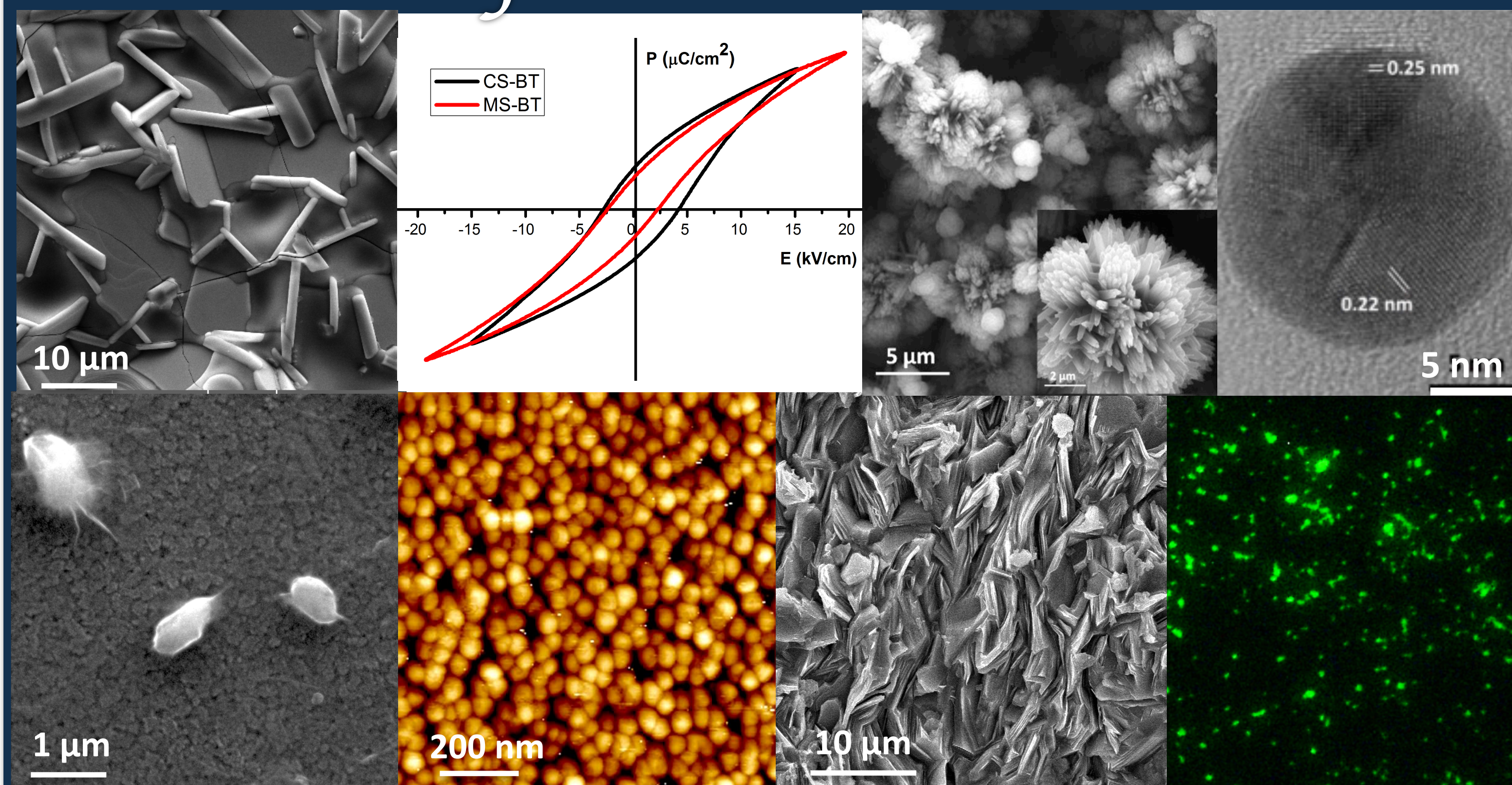

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O - 11

Evolution of Complementary Switching in Titanium Oxide Based RRAM by Annealing

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On the way towards high memory density and device performance, a substantial development in energy efficiency represents the leading aspiration in future information technology [1-2]. Complementary resistive switch is the combination of two antiserial resistive switching memory (RRAM) elements and permits for the construction of large passive crossbar arrays by solving the sneak path problem in combination with a drastic reduction of the power consumption. In this work we present a novel approach to transition from bipolar switching to complementary switching of a TiN(BE)/TiO_xN_y/TiO_{2-x}/Pt(TE) structure. Sputtering is used to grow TiOx layer. The devices have been characterized using XRD, AES, TEM and electrical measurements.

A forming process is necessary for the all as-deposited and annealed devices to initiate the forming process. All the as-deposited and annealed devices show bipolar switching. The 400°C annealed device shows complementary switch above 50 μA compliance current. During complementary switching operation the device set at 0.36 V and reset at 1.44 V during positive cycle and for negative cycle the device set at -0.28 V and reset at -1.2 V. The CRRAM device shows good endurance and retention. A clear formation of oxygen gradient layer at TiO_{2-x} and interfacial 10 nm TiO_xN_y layer are observed from AES and HRTEM spectra. Based on AES and HRTEM observation and with the help of schematic structures the complementary switching mechanism is explained. This paper provides valuable data along with analysis on the origin of CRRAM for the application in nanoscale devices. This structure has the potential for use in highly dense crosspoint memory without the cell selection devices.

Keywords: Non-volatile memory, Titanium oxide, RRAM, complementary switching,

References:

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O - 12

The development of high-temperature microwave furnace for synthesis of high-efficiency thermoelectric materials

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The thermoelectric material is a device that can generate electric energy from solar and waste thermal energies. On the other hand, It can generate temperature gradient from electric energy for cooling applications. Recently, researchers are interested in the synthesis of thermoelectric material by using microwave furnace. The efficiency of thermoelectric materials can be increased by microwave assisted synthesis because of rapid sintering and small gain size. High-temperature microwave

furnace technology is complicated in the design and control system. The commercial furnaces are very expensive. In this research, we have developed high-power microwave furnace for synthesis of thermoelectric materials. The design of microwave furnace is optimized by Comsol multiphysics. Study of electric distribution in the waveguide and cavity, therefore furnace cavity is optimized to be 28x28x28 cm^3. The waveguides and magnetrons are mounted on the four sides of the cavity. Each two waveguides on the opposite sides are placed at 90 degree to each other. *The* Heating of SIC crucible in the furnace have shown that crucible's temperature can be increased from room temperature to 900^o C within only about ten minutes. Heat energy in the furnace depends on the number of operating magnetrons, which is consistent with the distribution of the calculated electric field.

Keywords : microwave furnaces, multimode,cavity, waveguide, Comsol multiphysics.

O - 13

Synthesis of Single-crystalline BiFeO3 Nanoparticles and Their Magnetic Properties

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Single-crystalline multiferroic $BiFeO_3$ (BFO) nanoparticles with R3c space group have been synthesized via sol-gel method. The BFO nanoparticles exhibit weak ferromagnetism at low temperature and paramagnetism at room temperature. The remanent magnetization and coercive field of the BFO nanoparticles were measured (at 2 K) to be 0.062 emu/g and 1548 Oe, respectively. FC/ZFC curves show a split at ~ 62 K, which indicates that the BFO nanoparticles are also ferromagnetic. An unexpected abrupt increase of the magnetization at ~10 K was found in the ZFC curve, which could be ascribed to a competition between the ferrimagnetization (particle sizes smaller than 62 nm) and anti-ferromagnetization (particle sizes larger than 62 nm) since the size distribution of the as-synthesized particles was from 20 nm to 200 nm. In addition, M-H loops reveal an exchange bias effect in the BFO nanoparticles, which reaches a maximum at 10 K.

Keywords: $BiFeO_3$ Nanoparticles; Sol-Gel Processing; Magnetic Properties

O - 14

A Non-Destructive Free Space Characterization Technique for Extraction of the Intrinsic Electromagnetic Properties of Dielectric/Magnetic Composites

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A novel time and frequency domain measurement technique is proposed to facilitate the extraction of constituent electromagnetic properties e.g, complex permittivity and complex permeability of the material under test (MUT). The overall process is noninvasive and noncontacting, which consists of a pair of focusing horn lens transmitting and receiving antenna mounted on a aluminum table covered using the pyramidal absorber foams. The ratio of focal distance to diameter of the horn lens is unity, a special designed sample holder is placed at the common focal plane for holding the samples and is mounted on a micrometer-driven carriage. To this end, a novel algorithm is employed for extraction of complex permittivity and permeability of the MUT in terms of measured reflection and transmission coefficients. From the practical point of view, the main advantage of the proposed scheme is that it is ideally suited for measurement of isotropic/anisotropic planar sheets/composites, further the measurement can be carried at the high temperature(up to 1200°C) and low temperature(upto-20°C) using various temperature cells. The proposed technique is validated by extracting the relative permittivity, loss tangent of various standard materials, such as teflon, plexiglass etc., and compared the extracted data with their values available in the literature.

Keywords: complex permittivity, material under test, temperature cells.