

**COLOQUIO DE  $\Phi$ ÍSICA**

UNIVERSIDAD DEL VALLE

Departamento de Física &

Posgrado en Ciencias-Física



---

*Serie de Coloquios Semestre II-2012*

## **Experimental Challenges in Synthesis and Processing of Multiferroic BiFeO<sub>3</sub> Ceramics**

**Dr. Juan Muñoz Saldaña**

*Centro de Investigación y de Estudios Avanzados (CINVESTAV)-IPN,  
Santiago de Querétaro -- México*

### **Abstract:**

Bismuth ferrite (BiFeO<sub>3</sub> or BFO) is a magnetoelectric multiferroic material with coexisting ferroelectric and magnetic orderings. BiFeO<sub>3</sub> is being considered as a candidate for the next generation of ferroelectric random-access memory devices as high quality epitaxial thin films. The methods to obtain high quality epitaxial thin film have been already reported in the literature. In our group, the preparation of epitaxial BiFeO<sub>3</sub> thin films, grown on SrRuO<sub>3</sub>/SrTiO<sub>3</sub> substrates by pulsed laser deposition (PLD) have been successfully obtained by using BiFeO<sub>3</sub> ceramics with 10% excess of BiFeO<sub>3</sub> to be used as targets. However, there is a lack in the understanding of the sintering behavior and most important in the thermodynamic associated to the synthesis of bulk polycrystalline phase-pure BFO ceramics. Difficulties arise because of a narrow temperature range of phase synthesis and sintering between 750 and 850°C. Various impurity phases have been reported to occur, mainly comprising of Bi<sub>2</sub>Fe<sub>4</sub>O<sub>9</sub>, Bi<sub>12</sub>(Bi<sub>0.5</sub>Fe<sub>0.5</sub>)O<sub>19.5</sub> and Bi<sub>25</sub>FeO<sub>40</sub>. Presence of such impurities results in high current leakage issues, leading to poor ferroelectric behavior. Magnetic behavior of the samples is dependent on the presence of spurious phases and necessarily mixed valence states of iron. Thus, the nominal anti-ferromagnetic behavior tends to show some level of hysteresis, associated to ferromagnetic behavior, undesirable for exchange bias applications. In this talk, we present the current results, challenges and strategies that include a comparative study of the synthesis of BiFeO<sub>3</sub> ceramics synthesized and sintered using rapid liquid sintering process of powders milled under

different environments (dry and wet conditions). Raman spectroscopy and Piezo response force microscopy results will be shown as the ideal tools to use towards the understanding of the phase transformations associated to the synthesis and processing of  $\text{BiFeO}_3$  ceramics. This talk is meant to open the discussion related to the current status of the experimental efforts in the processing of  $\text{BiFeO}_3$  ceramics.

Diciembre 11 de 2012 | 11:00 AM | Sala de Conferencias de Física  
Edificio de Ciencias Naturales y Exactas | Espacio 320-2182