Hematite/Ilmenite (FeTiO3)-(Fe2O3) superlattices by PLD : new magnetic and transport properties

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Development of materials that show both magnetic and semiconducting properties is crucial for the realization of semiconductor-based spintronic devices. The solid solutions between ilmenite (FeTiO3) and hematite (α-Fe2O3) have recently attracted considerable attention due to their interesting magnetic and electronic properties that are strongly dependent on ordering of cations as well as composition [1-3]. Ferrimagnetic semiconductors arise when the arrangement of cations is ordered, whereas weak frustrated disordered magnetism is observed for disordered cation distribution. The Curie temperatures of ordered phases are higher than room temperature for compositions between 50 mol.% and about 80 mol. % of FeTiO3. DFT calculations have predicted a charge transfer at Fe2O3 and FeTiO3 interfaces in superlattices [6], generated interface magnetism with "giant exchange-bias" [7]. Such effects have been observed natural metamorphic mineral of nanocrystals.

By Pulsed Laser Deposition, artificial modulated composition hetero-structures (Fe2-xTixO3-d/FeTiO3)n have been epitaxially deposited on α-Al2O3(0001) substrate, varying the period thickness and the number of periods. Chemical composition has been measured by SIMS and XPS profiles. Room temperature magnetic loops exhibit large exchange bias (0.1 T) and stronger coercive field that single materials thin films. Measured Curie temperature of magnetization is 325K. Transport properties of these artificial superlattices have been investigated.

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