Temperature dependence on the magnetic, morphological and structural properties of $Fe_3O_4(111)/SrTiO_3(111)$ thin films grown by PLD

J. López-Sánchez,[1,2] J. Rubio-Zuazo,[3,4] I. Arnay,[3,4] A. Muñoz-Noval,[5] A. Serrano,[3,4] N. Carmona,[1,2], O. Rodríguez de la Fuente[1,2] and G. R. Castro[3,4]

1 Departamento de Física de Materiales, Universidad Complutense de Madrid, 28040 Madrid, Spain.
2 Unidad Asociada IQFR (CSIC)-UCM, 28040 Madrid, Spain.
3 Spanish CRG, Spline, The European Synchrotron (ESRF), 38000 Grenoble, France.
4 Instituto de Ciencia de Materiales, Consejo Superior de Investigaciones Científicas (ICMM-CSIC), Madrid, Spain.
5 Department of Applied Chemistry, Hiroshima University, Hiroshima, 739-8527, Japan.

jesus.lopez@ucm.es

Abstract
Despite the immense scientific literature regarding the oldest known magnetic material, magnetite has magnetic and structural properties still unveiled. Specifically, in the nanometric scale, many efforts are being developed in order to obtain high quality thin film layers with a preferred crystalline orientation [1]. This aspect is crucial for spintronic devices for optimal spin-polarized current in a metal/semiconductor heterojunction. In this sense, a positive spin polarization at the (111) surface of magnetite has been recently observed [2]. The chemically layered polar nature of the junction $Fe_3O_4(111)/SrTiO_3(111)$ might be employed as a scenario for studying spin injection from half metals into semiconductor materials. Therefore, aiming to discover the possible spin-polarized current effects, high quality $Fe_3O_4(111)$ epitaxial thin films (~30 nm) are grown on $SrTiO_3$ substrates by Pulsed Laser Deposition (PLD) as a function of temperature deposition (300-900 ºC). Depending on the different temperature stages, a homogeneous thin film or triangular Fe_3O_4 terraces as a single phase are formed. The structural properties and chemical composition of the epitaxial thin films are characterized by surface X-ray diffraction (SXRD), X-ray photoelectron spectroscopy (XPS) and confocal Raman microscopy (CRM). Apart from this, the magnetic properties of the samples are examined by a magneto-optic Kerr effect (MOKE) system in ultra-high vacuum (UHV). With this study we present not only a broad characterization of these epitaxial Fe_3O_4 samples, but also investigate the correlation between magnetic, morphological and structural properties as a function of the temperature deposition and how this could affect for the progress of future spintronic devices.

References
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Figures

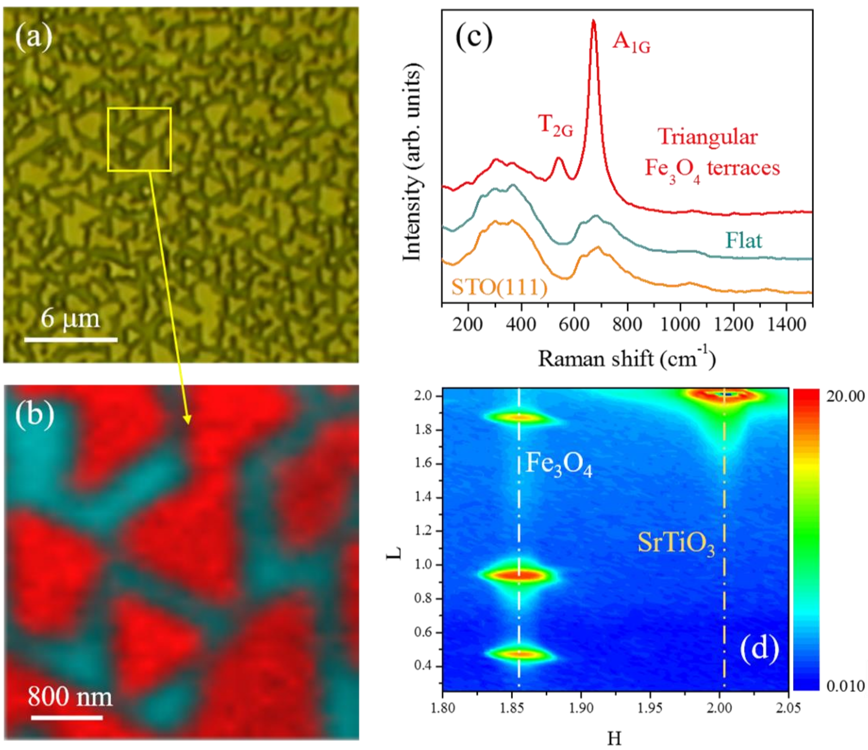

Figure 1. (a) Optical images of the sample grown at 900 °C; (b) In-plane Raman intensity image obtained from mapping the region marked with a red square in Figure A, measuring different single Raman spectra taken each 100 nm with an integration time of 0.5 s. Spectral ranges from 629 to 742 cm^{-1} for Fe_3O_4 triangular terraces (red color) and from 195 to 486 cm^{-1} for $SrTiO_3(111)$ contribution (soft blue color) were integrated to obtain the Raman intensity image; (c) Average Raman spectra obtained from in-plane Raman image; (d) Reciprocal space map evidencing an incommensurable growth along (111).