Pulsed laser deposition of Fe_2TiSn thin films for thermoelectric applications

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Thermoelectrics are promising to address energy issues but full potential exploitation requires improvements in their performance (large power factors and low thermal conductivities). Advanced thermoelectric materials from the class of Fe-based full Heusler semiconductors, Fe_2YZ, have been theoretically predicted to have very large power factors and to possess low-dimensional electronic transport even at bulk level. The aim of the present work was to grow thin films of Fe_2TiSn full Heusler compounds on magnesium oxide (MgO) buffer layers deposited on Si (100) using pulsed laser deposition (PLD). The buffer layer of MgO has been deposited by PLD onto Si (100) substrates, and its structure has been optimized with the preferential orientation along (100). Then, Fe-based Heusler compounds have been deposited onto MgO (100), using bulk targets of Fe_2TiSn. By optimizing the deposition parameters (substrate temperature, laser fluence and frequency), it was possible to control the stoichiometry, crystallinity and morphological properties of Fe_2TiSn thin films. We present the structural and morphological properties of these films investigated by X-ray diffraction, Atomic Force Microscopy and Scanning Electron Microscopy analysis.

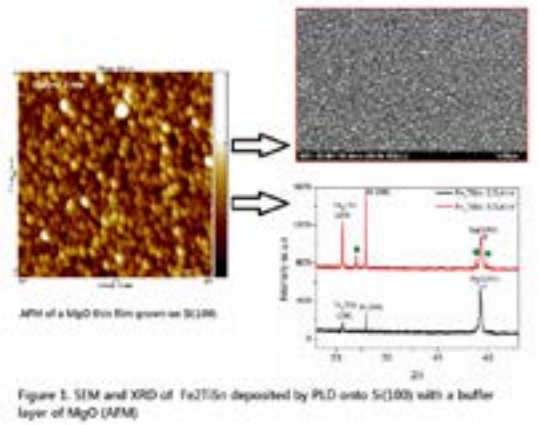

Figure 1. SEM and XRD of Fe2TiSn deposited by PLD onto Si(100) with a buffer layer of MgO (AFM)

Recent Publications

- Bilc DI, Hautier G, Waroquiers D, Rignanese GM, Ghosez Ph (2015) Low-Dimensional Transport and Large Thermoelectric Power Factors in Bulk Semiconductors by Band Engineering of Highly Directional Electronic States. Physical Review Letter 114:136601.
- Cáceres D, Vergara I, and Gonzalez R (2003) Microstructural characterization of MgO thin films grown by radio-frequency sputtering. Target and substrate-temperature effect. J. Appl. Phys. 93:4300.
- Niu F, Meler AL, Wessels BW (2006) Epitaxial growth and strain relaxation of MgO thin films on Si grown by molecular beam epitaxy. J. Vac. Sci. Technol. B 24:2586.
- Kaneko S, Funakubo H, Kadowaki T, Hirabayashi Y, Akiyama K (2008) Cubic-on-cubic growth of a MgO(001) thin film prepared on Si(001) substrate at low ambient pressure by the sputtering method. Europhys. Lett. 81:46001.
- Kaneko S, Ito T, Soga M, Motoizumi Y, Yasui M, Hirabayashi Y, Ozawa T, Yoshimoto M (2013) Growth of nanocubic MgO on silicon substrate by pulsed laser deposition. Jap. J. Applied Physics 52:01AN02.

Biography

Sorina Garabagiu has her expertise in pulsed laser deposition (PLD) of thin films, and their characterization using microscopic techniques (AFM, SEM) and spectroscopy (FTIR, UV-vis, fluorescence). She has performed PLD depositions of oxide materials, as buffer layers for advanced materials depositions, and semiconducting Heusler compounds, as potential thermoelectric materials. She also fabricated thin films of oxide materials by anodization, and arrays of metallic nanowires embedded into oxidic matrices, and 2D arrays of noble metal nanoparticles used for the design of electrochemical bio-sensors.

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