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Influence of segregation of divalent europium on magnetic and transport properties of MBE grown Eu-Fe thin films

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Due to potential ability of controlling the Eu valency and consequently switching between non-magnetic (Eu^{3+}) and magnetic (Eu^{2+}) states we examined the electronic structure as well as magnetic and transport properties of MBE grown Eu-Fe thin films. We considered that such Eu-based materials, in which the control of the valency of Eu would be possible, may be applied into new classes of spin-based sensor, memory or logic devices.

20-30 nm thick Eu-Fe films were grown on Si or GaAs (with a 50 nm thick buffer layer of Mo) in two different deposition modes — multilayer deposition and co-deposition [1]. The changes associated to the reaction with surrounding transition metal (monitored via Reflection High Energy Electron Diffraction and X-ray Photoemission Spectroscopy) lead to valency transition of europium $Eu^{2+} \leftrightarrow Eu^{3+}$. Ferromagnetic behavior of the Eu-Fe films up to the highest available temperature of 400 K and strong thermomagnetic effects, were observed via SQUID. The XPEEM images (X-ray Photoemission Electron Microscopy) indicate segregation of the divalent europium for selected films. Additionally observed anomalies in temperature dependence of electrical resistivity, obtained from 4-point probe measurements, may indicate frustration in magnetic ordering.

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Structural properties of $Ca_9R(VO_4)_7$ (R = La, Nd, Gd) single crystals: An X-ray diffraction study

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Whitlockite-related materials form an extended family of compounds. Those of the $Ca_9R(VO_4)_7$ formula (R = a rare earth) are considered for applications in optoelectronics, e.g., in white-light emitting diodes, as discussed in Refs. [1, 2]. In the $Ca_9R(VO_4)_7$ structure (space group *R3c*) the R atoms partially occupy the Ca sites, as has been shown in [3, 4]. In the present work, structural characterization of $Ca_9R(VO_4)_7$ (R = La, Nd, Gd) single crystals is performed using the powder diffraction and high-resolution diffraction.

$Ca_9R(VO_4)_7$ single crystals were grown by the Czochralski method. X-ray rocking curves and as reciprocal space maps were obtained using a laboratory high-resolution diffractometer. The rocking curves as well as the reciprocal space maps of symmetrical 0 0 30 and asymmetrical 1 0 16 reflection show that all three crystals are of high-quality, without any blocks or grains. An analysis of the X-ray diffuse scattering indicates on the presence of the point defects, in the form of vacancies. The crystals were verified to conserve the [001] orientation of the applied seed. The powder diffraction data for polycrystalline samples prepared from the single crystals were collected using a laboratory X'PERT diffractometer equipped with a Ge monochromator and a strip detector. Phase analysis has shown that the crystals are pure $Ca_9R(VO_4)_7$ phases. The results of Rietveld refinements show a general consistency with literature data for polycrystalline samples prepared by solid state reaction [3, 4]. A small off-stoichiometry indicated by structure refinement correlates with the trends indicated by elemental analysis.

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