DS 4: Thin Film Properties: Structure, Morphology and Composition (XRD, TEM, XPS, SIMS, RBS, AFM, ...) 2

Time: Monday 11:00–11:45 Location: H14

DS 4.1 Mon 11:00 H14

Scaling and confinement in ultrathin chalcogenide films as exemplified by GeTe — •Peter Kerres — 1st Institute of Physics "new Materials", RWTH Aachen University, 52066 Aachen, Germany

Chalcogenides such as GeTe, PbTe, Sb2Te3, and Bi2Se3 are characterized by an unconventional combination of properties enabling a plethora of applications ranging from thermo-electrics to phase change materials, topological insulators and photonic switches. Chalcogenides possess pronounced optical absorption, relatively low effective masses, reasonably high electron mobilities, soft bonds, large bond polarizabilities and low thermal conductivities. These remarkable characteristics are linked to an unconventional bonding mechanism characterized by a competition between electron delocalization and electron localization. Confinement, i.e. the reduction of the sample dimension as realized in thin films should alter this competition and modify chemical bonds and the resulting properties. Here, we demonstrate for crystalline films of GeTe pronounced changes of optical and vibrational properties, while amorphous films of GeTe show no similar thickness dependence. For crystalline films, this thickness dependence persists up to remarkably large thicknesses of 40 nm. x-ray diffraction and accompanying simulations employing density functional theory relate these changes to thickness dependent structural (Peierls) distortions, due to an increased electron localization between adjacent atoms upon reducing the film thickness. We expect a thickness dependence and hence potential to modify film properties for all chalcogenide films with a similar bonding mechanism .

DS 4.2 Mon 11:15 H14

Solid-state microstructural evolution and dewetting of Co_xCu_{100-x} thin films — •Farnaz Farzam[1], Bárbara Bellón[1], Matteo Ghidelli[1,2], María Jazmin Duarte Correa[1], Dominique Chatain[3], and Gerhard Dehm[1] — [1]Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf, Germany — [2]LSPM, CNRS, Université Sorbonne Paris Nord, Villetaneuse, France — [3]Aix-Marseille Univ, CNRS, CINaM, Marseille, France

Metallic thin films can undergo severe microstructural and morphological evolution, while maintaining their solid state at high temperatures below their melting point(T_M). These structural changes such as hillock formation and texture evolution can be followed by solid-state dewetting(SSD) in which capillary forces finally break up the film into isolated particles. Here, we investigate the microstructural evolution of Co_xCu_{100-x} thin films with x equal to 15, 38 and 75 at.%. Films were deposited on (0001) sapphire and annealed below their T_M. Subsequently, characterization has been carried out using scanning and transmission electron microscopy(SEM, TEM), and X-ray diffraction(XRD). Upon annealing, Cu-rich hillocks form in all three compositions prior to voids at which dewetting initiates. The onset temperature of the formation of these hillocks depends on the composition of the film. Moreover, a phase separation of FCC Co and FCC Cu is observed. Finally, we show an orientation relationship of Cu (FCC) and Co (FCC)-rich isolated particles with sapphire: $Cu/Co(111) \pm [1\bar{1}0] \parallel Al_2O_3(0001)[10\bar{1}0]$.

DS 4.3 Mon 11:30 H14

Analysis of 3D check board pattern formation in NiCoMnAl shape memory alloys with alternating austenitic and martensitic layers — •Dario Stierl, Andreas Becker, Laila Bondzio, Tapas Samanta, Inga Ennen, and Andreas Hütten — Center for Thin Films and Physics of Nanostructures, Physics Department, Bielefeld University, 33615 Bielefeld, Germany

NiMnX (X=Al,Ga,Sn,In) magnetic shape memory Heusler alloys are considered as promising materials for magnetocaloric cooling applications due to their magnetoelastic coupling near room temperature. The thermal hysteresis could be reduced in NiCoMnAl thin films with alternating active transforming austenitic layers and martensitic intercalations. The stoichiometry of these two layers is chosen in such a way that their thermal hysteresis does not overlap. In addition, a 3D check board pattern becomes visible in HRTEM cross section images if the austenite active layers and martensite intercalations possess similar thicknesses.

In this contribution we aim for an improved understanding of the 3D check board pattern formation. Therefore, we varied the number of the alternating layers in one series and changed the ratio between the thicknesses of the two different layers in a different series. Furthermore, we analyzed the samples with XRD and temperature dependent magnetization measurements.