Contribution ID: **14** Type: **not specified**

Self-diffusion and roughness correlation in isotopic 56Fe/57Fe bilayers

Friday 23 May 2014 08:30 (30 minutes)

Self-diffusion, a fundamental matter transport process in materials, is important for preparation, processing, and heat treatment of materials. To investigate the mechanism of self-diffusion, one needs to fabricate structures with proper isotope labeling. In our present work, isotope bilayers of 56Fe/57Fe with two different thicknesses with the purpose of comparing the diffusion process in samples with a plausible variation in the grain size were prepared by molecular beam epitaxy (MBE). The samples are of the following compositions 56Fe(2nm)/57Fe(2nm)/Pt(20nm) and 56Fe(5nm)/57Fe(5nm)/Pt(4nm), labeled as Fe5 and Fe2, respectively. The Pt layer on top of Fe layer is used to avoid oxidation. As-deposited samples were cut into six pieces (sample Fe5) and three pieces (sample Fe2) and were annealed at 473K for different annealing times. The thickness and roughness of the films were obtained using X-ray reflectivity (XRR). The lateral and longitudinal correlation length of roughness were investigated by x-ray diffuse scattering (XDS) and longitudinal off-set scans. Grazing-incidence small-angle x-ray scattering (GISAXS) was used to investigate the lateral correlation lengths which allow different bandpass of roughness as compared to that obtained from XDS. We have an interdiffused layer in between Pt and Fe layer even for the as-deposited specimens. The thicknesses and the scattering length densities of Fe, Pt and the interdiffused layers of the annealed samples remain fairly similar. Interestingly, two stages of evolution associated with a variation in the in-plane correlation lengths for each stage were identified from GISAXS measurement. Owing to the large difference in coherent neutron scattering length of 57Fe (2.3fm) and 56Fe (9.45 fm), neutron reflectometry (NR) can be effectively used to study the self-diffusion with annealing time. Additionally, using grazing incidence small angle neutron scattering (GISANS) we plan to investigate the change in correlation of Fe (domain correlations) in these systems. Multilayers of [56Fe(5nm)/57Fe(5nm)]5 and [56Fe(5nm)/57Fe(5nm)/Pt(5nm)]5 are being prepared and compared with the bilayers. Using our experimental chamber for in situ neutron scattering experiment we plan to compare the diffusion and change in correlation length with our ex situ results.

Author: Ms GONG, Jing (Physik-Department E21, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany)

Presenter: Ms GONG, Jing (Physik-Department E21, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany)

Session Classification: Student Sessions