MS41-P3 Anomalous x-ray diffuse scattering from nanoparticles in single crystalline Ti alloys

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Metastable β-titanium alloys are the most prospective and versatile group of titanium alloys, as they exhibit high specific strength and good fatigue and corrosion resistance. The properties of these materials are substantially affected by alloying elements, which affect the martensitic phase transition to hexagonal ω phase, which is observed as particles of around 10-20 nm in size uniformly dispersed throughout the β matrix. The chemical composition of the ω nanoparticles and their changes during ageing from the starting quenched structure is of particular interest, since the out-diffusion of alloying atoms from the volumes of the growing nanoparticles controls the kinetics of the particle growth. We have investigated the evolution of the chemical composition of the ω nanoparticles in single crystals of Ti+8%Mo during annealing at various temperatures, using anomalous x-ray diffraction and diffuse scattering. In this experiment we measured diffuse x-ray scattering around the diffraction peaks of the ω- and β-phases for various energies in the range ± 100 eV around the MoK absorption edge, after various annealing steps. From the reciprocal-space maps of scattered intensity taken at various energies we extracted the energy dependences of the intensity scattered into various reciprocal-space points around the chosen reciprocal lattice point (RELP). Figure shows atypical reciprocal-space intensity distribution around the (006)β RELP (panel a) and the energy dependences of the intensities extracted from rectangular regions 1-3 (b). From the data we were able to determine the densities of the Mo atoms in various iso-strain volumes around a ω-nanoparticle and together with elasticity theory simulations we reconstructed the profile of the Mo density around the particle. From the data taken at the ω RELP we found that a nanoparticle consists of a core with higher Mo content and a shell with almost no Mo atoms.

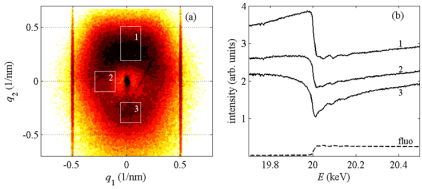

Figure 1. (a) Reciprocal-space map around the (006)β maximum at 19.95 keV. (b) Energy dependences of the intensity extracted from the regions denoted by white rectangles in panel (a).

Keywords: Anomalous x-ray scattering, diffuse scattering, nanoparticles, Ti alloys

MS41-P4 Multiple Bragg reflections of neutrons accompanying a strong allowed reflection at a constant neutron wavelength

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In our contribution, the neutron diffraction results of particular studies of multiple Bragg reflection (MBR) effects accompanying a strong Si(111) reflection in the cylindrically bent perfect crystal at the neutron wavelength of 0.162 nm will be presented. Contrary to a common view that MBR effects could be considered negligible or represent maximally a few percent of an effect related to a single allowed reflection, it is shown that in the case of a homogeneously deformed perfect single crystal (in our case of cylindrically bent Si crystal) and particular diffraction geometry they can be even several times higher. For searching the MBR effects, the method of azimuthal rotation of the crystal lattice around the scattering vector of the primary reflection for a fixed wavelength was used. Cylindrically bent perfect crystal slab of Si was set in the symmetric transmission geometry for diffraction on the lattice planes (111). It has been found that multiple Bragg reflections realized in bent perfect crystals can provide intensive highly monochromatic beams which are parallel to the diffracted beam corresponding to the primary reflection. The present investigation points out on the necessity of considering the presence of MBR effects in accurate measurements of primary reflection intensities, namely, in the case of deformed single crystals.

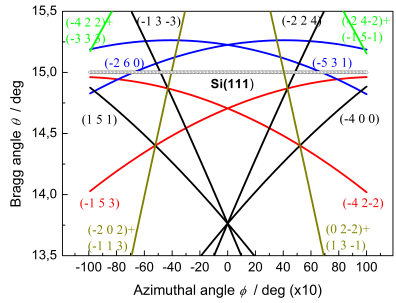

Figure 1. Part of the azimuth-Bragg angle relationship for 111 primary reflection of the diamond structure at the vicinity of the Bragg angle of 15° as used in the experiment. Indexes are related only to the secondary reflections.

Keywords: Multiple reflections, neutron diffraction, bent perfect crystals