phases associated with intriguing solid-solid phase transformations), the atomistics of interfacial structure and growth mechanisms of many precipitate phases remains poorly understood.

Here we present a structural study by aberration-corrected scanning transmission electron microscopy (STEM) of Al-Cu precipitate phases in several model aluminium alloys. These phases, Guinier-Preston (GP) I zones, theta" (Al_3Cu) and theta' (Al_2Cu) phases, are classic crystalline precipitates of the simplest age-hardened alloys [1], [2]. Using a combination of experimental and simulated high-angle annular-dark-field STEM imaging, we demonstrate that these well-known phases in fact exhibit structural features hitherto unreported. Atomic-scale models of interfacial structures are provided. Furthermore, trace additions of Sn are shown to result in precipitate nanoscale thicknesses exhibiting "magic" values. These findings resolve a long-standing mystery [3] and provide new insights into the atomistic mechanisms of precipitate growth in these systems.

[1] A. Guinier, *Nature* **1938**, *142*, 569-570. [2] G.D. Preston, *Nature* **1938**, *142*, 570. [3] J.M. Silcock, T.S. Heal, H.K. Hardy, *J. Inst. Metals* **1955-56**, *84*, 23-31.

Keywords: aluminium, precipitate interface, TEM.

MS21.P07

Acta Cryst. (2011) A**67**, C337

A simultaneous multiple angle-wavelength dispersive X-Ray reflectometer

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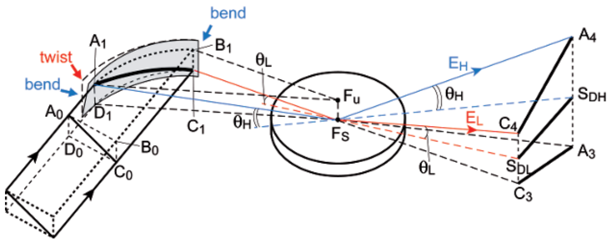
In previous studies[1], [2], [3], we reported a method of measuring specular X-ray reflectivity curves with no need of angle scanning of the sample, detector and monochromator crystal during the measurement. In this method, the reflectivity curve is measured with a position sensitive detector as a function of X-ray energy using a convergent X-ray beam which has a one-to-one correspondence between direction and energy. Because the practically covered energy range was limited, the measured range of the momentum transfer ($q=4\pi\sin\theta/\lambda$: θ and λ being the glancing angle and wavelength of the X-ray beam) was not wide enough for quantitative analysis.

In the present study, we report improvements of the method for widening the simultaneously covered rang of the momentum transfer by realizing a convergent X-ray beam with which the wavelength (energy) and the glancing angle to the specimen surface of the X-ray beam change continuously at the same time as a function of direction. For realizing such a convergent beam, we used a bent and twisted crystal. An inclined slit is placed upstream of the crystal, so that the foot print of an X-ray beam is along a line from the upper left to lower right corners of the crystal. The crystal is elliptically bent in the horizontal plane and furthermore twisted around the cross line of the crystal surface and the horizontal plane. The beam reflected at the upper left corner is slightly deflected downward, while that at the lower right keep the same vertical direction. Another big improvement is the use of a pixel array detector (PILATUS 100K) instead of an X-ray CCD.

Reflectivity curve profiles from a silicon wafer were simultaneously recorded covering a q range from 0.05 to 0.5 Å^{-1}. Measured minimum reflectivities were 1×10^{-8} and 1×10^{-6} with data collection times of 100 s and 1 s, respectively.

We will report results of a performance test experiment and discuss means to further improve the performance of the reflectometer including the time resolution.



Geometry of simultaneous multiple angle-wavelength dispersive X-ray reflectometer

[1] T. Matsushita, Y. Niwa, Y. Inada, M. Nomura, M. Ishii, K. Sakurai, E. Arakawa, *Appl. Phys. Lett.* **2008,** *92***,** 024103. [2] T. Matsushita, E. Arakawa, Y. Niwa, Y. Inada, T. Hatano, T. Harada, Y. Higashi, K. Hirano, K. Sakurai, M. Ishii, M. Nomura, *Euro. Phys. J. Special Topics* **2009,** *167***,** 113. [3] T. Matsushita, E. Arakawa, T. Harada, T. Hatano, Y. Higashi, Y. F. Yano, Y. Niwa, Y. Inada, S. Nagano, T. Seki, *AIP Conf. Proc.* **2010,** *1234***,** 927-930.

Key words: X-ray_reflectivity_curve, simultanous_measurement, multiple_angle-wavelength_dispersive

MS21.P08

Acta Cryst. (2011) A**67**, C337-C338

Long-range order and interface stability in Co_2FeSi/GaAs hybrid structures

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Ferromagnet/semiconductor hybrid structures are well suited for spin injection as a first step towards the design of spintronic devices. The half-metallic and ferromagnetic Heusler alloy Co_2FeSi exhibits a high degree of spin polarization as well as a large Curie temperature of about 1,100 K and is perfectly lattice matched to the semiconductors GaAs and Ge. Spin injection has already been demonstrated. The properties of the ferromagnet/semiconductor interface and long-range order in the Heusler alloy are important for an improvement of the spin injection efficiency. The Co_2FeSi structures on GaAs are grown by solid source molecular beam epitaxy. The long-range order and the interface stability of the structures are investigated by transmission electron microscopy (TEM), x-ray diffraction, atomic force microscopy (AFM) and secondary ion mass spectrometry. At high substrate temperatures T_S during growth, a precipitation process near the Co_2FeSi/GaAs interface is observed, which is connected to an enhanced diffusion of Co, Fe, and Si into GaAs. We use the value of T_S at which precipitation begins as the limit of the interface stability. The critical value of T_S depends on the crystallographic orientation of the interface. For (001) and (110) interfaces, these temperatures are near T_S= 250°C and T_S= 200°C, respectively, whereas for the (111) interface this temperature limit is considerably higher: T_S= 325°C. As a result, the (111) interface is the most stable interface, and an overgrowth of the ferromagnetic film with Ge could be possible for this orientation [1]. The figure demonstrates the surface roughness of the Co_2FeSi film measured by AFM for two orientations of the interface (110 and 111) and several growth temperatures T_G.

For a quantitative characterization of long-range order we determine the average order parameters in Co_2FeSi using x-ray diffracttion and image the lateral inhomogeneities of the compositonal order in the films on the nanometer scale using the dark-field mode of TEM with superlattice reflections. A fundamental reflection is insensitive to long-range order, and the dark-field image of that reflection is usually almost homogeneous. A superlattice reflection images the distribution of long-