

Abstract No. Reic0314

Diffuse Scattering of AuNi Using High Energy X-Rays

H. Reichert, A. Schoeps, I.B. Ramsteiner, H. Dosch (MPI fuer Metallforschung Stuttgart) and Z. Zhong (BNL, NSLS)

Beamline(s): X17B1

Introduction: In previous experiments at the NSLS high energy beamline X17B1 we have developed a highly efficient way to measure the diffuse scattering of single crystals in a very short time. We use this method to investigate the diffuse scattering of various alloys.

Methods and Materials: The technique has been described more detailed in an earlier experimental report [1]. We use a MAR-CCD detector to record the diffuse scattering in transmission geometry. The high energy of the photons (67 keV) allows to penetrate samples with a thickness up to several millimeters, yielding a large number of scatterers in the scattering volume. In addition, the surface of the extremely big Ewald sphere is almost flat in the region of interest. Thus, this method allows to collect the scattered intensity in the first Brillouin zone with excellent resolution in a few seconds [2].

Results: Beside investigating the diffuse scattering of NiPt, CuAu and Ni₃Al single crystals, our main interest was the temperature-dependent diffuse scattering (300K to 1000K) of the alloy Au₄₀Ni₆₀, which has attracted a lot of interest recently. According to the phase diagram, this alloy forms a fcc disordered solid solution at temperatures between the melting point (950°C) and 800°C. Below the latter temperature it shows phase separation. Although this clustering tendency gives rise to diffuse scattering around the Γ point only, we observe additional diffuse intensity maxima within the Brillouin zone, indicating competing ordering tendencies.

Conclusions: Comparing the experimental findings to first-principles calculations and a recently developed model for strain-induced interactions [3] we attribute the two competing ordered structures to different physical origins.

References:

[1] H.Reichert, P.Riegger and H.Dosch, "Ultrafast Measurements of Diffuse Scattering Using High Energy Photons"; NSLS Activity Report (1999) 7-203.

[2] H.Reichert, V.N.Bugaev, O.Shchyglo, A.Schoeps, Y.Sikula and H.Dosch, "Strain Induced Nonanalytic Short-Range Order in the Spin Glass Cu₈₃Mn₁₇"; Phys.Rev.Lett. **87**, 236105 (2001)

[3] V.N.Bugaev, H.Reichert, O. Shchyglo, A.Udyansky, Y.Sikula and H.Dosch, "q-space configurational energy and short-range order in alloys with atomic size mismatch"; Phys.Rev. B **65**, 180203 (2002), rapid communication

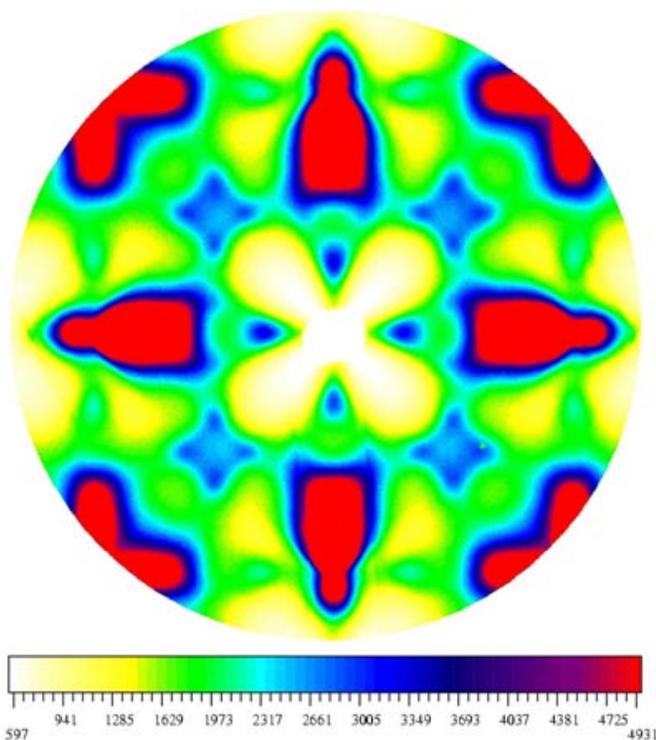


Figure 1. (100) oriented scattering pattern of Au₄₀Ni₆₀ at 300K