ESRF	**Experiment title:** Self diffusion in crystal lattice with nuclear resonant scattering of synchrotron radiation on superstructure Bragg reflection	**Experiment number:** HS-1029
Beamline: ID22N	**Date of experiment:** from: 30-Sep-99 to: 7-Oct-99	**Date of report:** 20-Feb.-00
Shifts: 15	**Local contact(s):** Helge Thiess, Tanja Asthalter	*Received at ESRF:* 28 MAR. 2000

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Report:

Nuclear resonant scattering (NRS) of synchrotron radiation is a tool to measure atomic motion in solids [1]. With this method not only jump rates but also jump vectors can be determined and the knowledge of the complete diffusion mechanism can be deduced [2]. NRS combines the advantages of the high brilliance of SR with the high energy resolution of nuclear methods like quasielastic neutron scattering and quasielastic Mössbauer spectroscopy. SR scattered from ordered crystalline solids keeps its coherency not only in forward direction but also in Bragg directions. Measurements in Bragg directions gives the opportunity to investigate brittle samples which cannot be prepared as thin foils.

In this project we have measured the delayed scattering into Bragg directions on FeAl and pure α-Fe samples. The aim was to verify the scattering mechanism in Bragg geometry and to compare the results with the spectra under the influence of self diffusion obtained during the previous beamtime. An iron single crystal grown with its (110)-direction normal to its surface and FeAl crystal with (111) orientation were mounted on a

The time spectra for the counts of 14.4 keV resonant photons were measured in direction of the reflection from the (110) and higher orders for the Fe sample and the (222) plane at two different temperatures for the FeAl sample. Fig. 1 shows two typical time-spectra for Fe and FeAl together with the simulations following the dynamical Bragg scattering of resonant quanta. The beat structure in the case of the Fe-sample is a result of the well polarized synchrotron beam together with the magnetic polarisation of the sample perpendicular to the scattering plane whereas the FeAl sample shows no magnetic structure. One can see that the measured spectra coincide well with the simulated spectra which are based one the theory of nuclear resonant Bragg scattering in the presence of strong electronic scattering and different degrees of mosaicity in the sample. To account for the mosaicity we introduced a simple model treating the mosaic crystallites as randomlike misalligned distribution of small scatterers around the exact Bragg angle. The result is a combination of the forward and Bragg scattering effects inside the sample, leading to a stronger "speed-up" of the delayed intensity. We can state now that *we can follow the scattering process irrespective of the crystal structures* and can *successfully explain the nuclear scattering into Bragg directions under the influence of self diffusion* [3] (see the report HS-584). In addition we investigated the mosaic structure of these samples by measuring rocking curves at different orientations and reflections and determined the reflectivity.

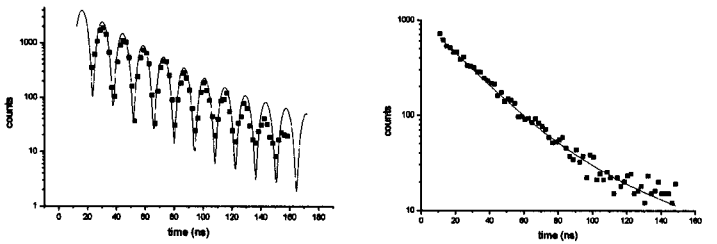

Fig. 1. Delayed intensity scattered from the α-Fe single crystal (left) and FeAl crystal (right); lines are calculated using the dynamical theory of Bragg-scattered resonant radiation.

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[3] H. Thiess, M. Kaisermayr, B. Sepiol, M. Sladecek, R. Rueffer, G. Vogl, Self diffusion in crystal lattice