ESRF	**Experiment title:** Study of disordered Cu-Ni alloys by (y, eγ)-spectroscopy	**Experiment number:** HE-158
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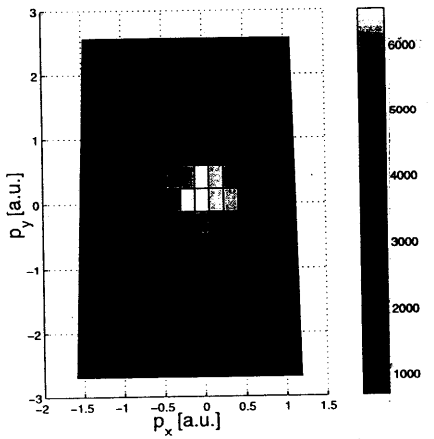
Report:

(y, eγ)-spectroscopy, i. e. the coincident detection of an inelastically scattered high energy photon and its recoil electron, allows the measurement of the complete 3D-electron momentum density (EMD) of solids. It was the aim of this experiment to investigate the influence of alloying on the EMD. Since the emerging electron is strongly influenced by multiple scattering within the target very thin target foils must be used. The idea of the experiment is the following: first a sandwich-like foil has been measured consisting of a double layer of 200Å Ni / 200Å Cu on a 320Å carbon backing, followed by the measurement of a sandwich target which was heat treated for lh at 500°C. Secondary ion mass spectroscopy' (SIMS) of that foil revealed that complete interdiffusion had occurred, which agrees with Ni / Cu diffusion data[2]. Since Ni / Cu are without a mixing gap it is assumed that a disordered substitutional alloy has been formed by this treatment. The difference of both EMDs should show the influence of the alloy. A new (y, eγ)-spectrometer has been build up at the ESRF including especially a scattering chamber and a 2D-position sensitive electron detector consisting of 256 photodiodes. For a primary photon energy of 150 keV a detailed Monte Carlo study of the 3D-momentum resolution showed an ellipsoidal shaped volume with standard deviations σ=(0. 12, 0.17, 0.20) a.u. in (p,, p_y, p,) direction. For a monochromatized beam with $\Delta\omega$=500 eV we obtained an overall

coincidence rate of about 5.2 Hz with virtual no chance coincidences. Fig. 1 shows a plot of the angular correlation intensity obtained with the new electron detector, i. e. for a fixed position on the electron detector all events in the photon channel have been summed up. Thus Fig. 1 is the analogone of angular correlation plots of positron annihilation experiments. It is evident that the 2D-projection of the 3D-EMD of the Cu / Ni sandwich can be seen. To increase statistics we have summed the intensity of all pixels (photon and electron branch) for a constant momentum p. In Fig. 2 the difference between the sandwich and the heat treated foil (stars) together with a theoretical EMD difference $\Delta\rho=1/2\rho_{Cu}(p)+1/2\rho_{Ni}(p)-\rho_{Cu50Ni50}(p)$ (solid line) are plotted. $\Delta\rho$ was obtained from a Korringa-Kohn-Rostoker coherent potential calculation by Benedek et al.[3], which was convoluted by our 3D-resolution volume and corrected for multiple scattering effects. In Fig. 2 the absolute height of theory has been fitted to the data points though we emphasize that the magnitude of the alloy effect - appr. 2% at zero momentum - is correctly reproduced by the experiment within 30%. Certainly, theory does not contradict experiment, but it is also evident that statistics should be improved. (To be correct, most of the beam time was used to take the set-up into operation. The data of Fig. 2 corresponds to roughly 45h accumulation time.)



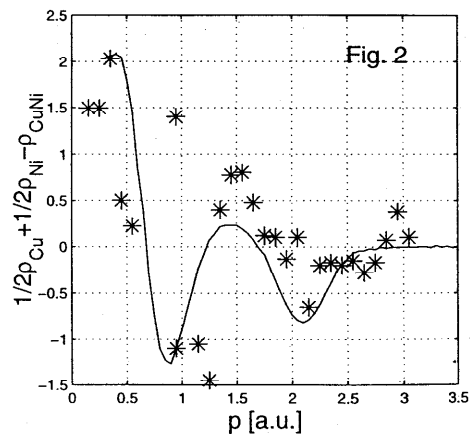


Fig. 1: Angular correlation distribution of the Ni / Cu sandwich. The (p_x, p_y) components are perpendicular to the momentum transfer vector.

Fig. 2: The difference of the EMD for the sandwich and the alloy. Experimental data (stars) and theory[3] (solid line).

[1] In collaboration with K. Wittmaack, GSG, Munich, Germany

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[3] R.Benedek, R. Prasad, S. Manninen, B. K. Sharma, A. Bansil and P. E. Mijnareds, Phys. Rev. B31 (1985) 7650