ESRF

Experiment title:

Structure of undercooked liquid metals

Experiment number:

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12	Adriano Filipponi	02 SEP 1996

Names and affiliations of applicants (*indicates experimentalists):

I. Egry, Institut für Raumsimulation, DLR, D-51 140 Köln

G. Jacobs*, Institut für Raumsimulation, DLR, D-5 1140 Köln

C. Notthoff, Institut für Raumsimulation, DLR, D-5 1140 Köln

D. Platzek*, Inst. f. Strahlen- und Kernphysik, Universität Bonn, D-531 15 Bonn

Report:

Electromagnetic levitation is a useful tool to process high temperature and highly reactive melts without a container. Due to this pure environment, contamination of the sample is reduced to a minimum and it is possible to undercool the liquid by several hundreds of degrees below the melting temperature, so that the metastable state of the melt is accessible for research.

Since liquids are poorly understood phases of matter, it is quite important to obtain new information about the structure, especially of the metastable phase, For studies of the short range order of a material, the EXAFS method is well established, which makes it interesting to combine both, levitation with EXAFS analysis.

For the experiments, samples of $Co_{80}Pd_{20}$ and $Co_{50}Pd_{50}$ alloys (diameter 5-6 mm) were positioned and molten by a high frequency alternating field, produced by a rf-generator and a levitation coil inside of a UHV-chamber. The temperature was measured by a pyrometer and was controlled by a variable flow of cooling gas.

It was possible to perform EXAFS measurements in a wide temperature range and reach undercooking of more than 300°C below the melting point of our samples. To reduce any effect of the unavoidable translational and surface oscillations on the EXAFS of the levitated sample, we used a focused beam of less than 1 mm^2 area and measured the fluorescence radiation nearly in the backscattering direction by two photodiodes.

Figure 1 shows the EXAFS of a levitated liquid Co80Pd20 sample above the K-edge of Co. The dotted line corresponds to a temperature of 1450°C, i.e. 100°C above the melting point, whereas the full line shows the EXAFS of a sample undercooked by 300°C. In both spectra the EXAFS oscillation is clearly visible in the k-range up to about 8 $Å^{-1}$. With a further reduction of the noise level, it should be possible to expand this range to higher k for a better interpretation of the data. The increasing amplitude of the EXAFS, as well as a decreasing wavelength with decreasing temperature is evident.

The analysis of the spectra to derive distance and number of nearest neighbors is under way.

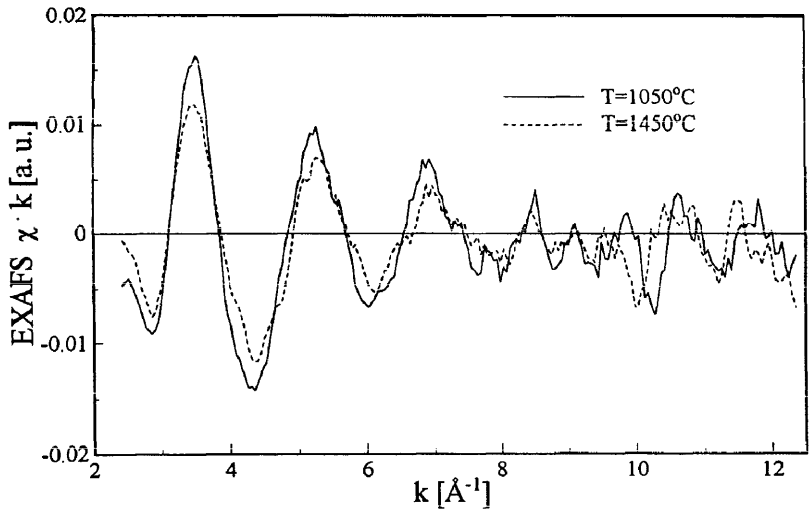

Fig. 1 k-weighted EXAFS spectra of levitated liquid Co80Pd20 at temperatures of 1450°C and 1050°C.