ESRF	**Experiment title: Fast relaxations in metallic glasses in undercooled liquid state**	**Experiment number**: SC-130
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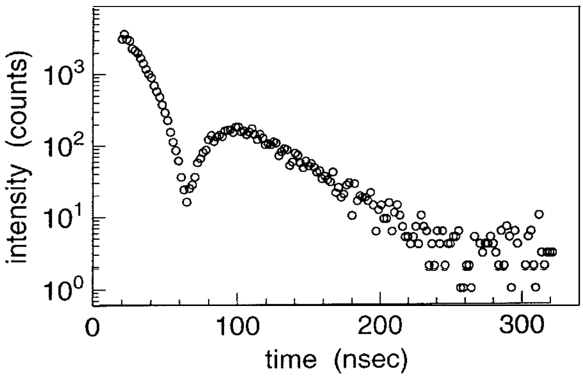
Report:

For long time studies of the glass transition in metallic glasses suffered from the strong tendency of metallic systems to crystallise at temperatures above the calorimetric glass transition T_g. This is in contrast to organic glass formers which may be heated through T_g and kept in the metastable undercooled melt for whatever time. Only recently the discovery of Zr based quaternary[l] and quinternary[2] glasses opened the possibility to investigate a metallic glass with steady state methods some 70 K above T,.

The aim of this experiment was to measure the Lamb-Mössbauer-factor in the undercooled melt and to search for diffusion effects in the nuclear forward scattering intensity. Conventional Mossbauer-absorption spectroscopy measurements[3,4] failed in observing any diffusional line-broadening, but clearly showed the onset of a decrease in the Lamb-Mossbauer-factor below the harmonic extrapolation some 20 K above T,. Nuclear forward scattering of synchrotron radiation is capable of yielding identical results[5], however with considerably reduced measuring times. While one spectrum had to be measured for 2 hours in the above mentioned experiment the time to collect one spectrum on ID18 was 20 minutes in hybrid mode. In a sucessive experiment in 16 bunch mode this could be further reduced to 2 minutes[6]. Measuring times in this range allow for measurements performed at constant heating rates.

Moreover the much faster counting makes it possible to heat the sample at rates of the order of 1 K/min thus extending the accessible temperature range by several 10 K. In this experiment we achieved a temperature interval of some 100 K in the undercooled melt, compared to 50 K in the QMS and neutron[7] measurements. The figure shows one typical spectrum measured at room temperature.



A wide range in the undercooled melt is of crucial importance for the interpretation of the decrease in the Lamb-Mössbauer-factor. On approaching the critical temperature of the glass transition T_c from low temperatures the Lamb-Mossbauer-factor is predicted to decrease critically towards a constant value above T_c[8]. Thus measurements must be performed as close as possible to T_c in order to verify this prediction. In metallic glasses this may only be achieved at high heating rates. In most molecular glass formers T_c is located some 20% above T_g, so in our case near 720 K. The fact that we do not see the square-root behaviour of the critical decrease indicates that in this metallic glass T_c is above 1.2xTg. A more detailed analysis of the results fails because is has not yet been possible to find a set of parameters consistent both with the measurements presented here and the Mössbauer-results[3].

As expected no effects of diffusion were visible, there is no acceleration in the decay of the intensity. On the timescale of Mössbauer experiments (several 100 nsec) diffusion sets in only at much higher temperatures, not accessible due to crystallization.

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