Vibrational Dynamics of $Pd_{80}Si_{20}$ Glass

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In this study the vibrational dynamics of $Pd_{80}Si_{20}$ glass have been measured using the inelastic x-ray scattering (IXS) technique. Exploratory experiments were performed in both reflection and transmission modes. The reflection signal was very weak from the melt spun-glass ribbons. However since the ribbons were quite thin (~μm), a reasonable transmission signal was obtained from these quite heavy elements. Indeed it is thought that these measurements may represent the first of their kind on such heavy elements, as previous studies have mainly concentrated on hydrogenous systems where the signal is stronger. At least two, possibly three, excitations are observed in the $Pd_{80}Si_{20}$ glass at momentum transfers within the first pseudo-Brillouin zone (BZ) Q_{BZ}=1.4Å^{-1}.

In all, five Q values were measured using IXS as shown in Fig. 1. The highest value Q=2.0 Å^{-1}, had previously been the subject of investigation of the complimentary technique—neutron Brillouin scattering (NBS) by us on the same sample. It is important to note that for this sample the weighting factors for x-ray and neutrons on each partial structure factor are almost identical and are dominated by the Pd-Pd contribution. The IXS measurements are restricted to low momentum transfers, around the first BZ where the excitations are sharpest and most easily identified, whilst kinematic constraints limit the NBS measurements to higher Q values. Nonetheless, in the overlap region, the IXS and NBS results are in good agreement, and the superior resolution obtained with the IXS technique (2.3 meV FWHM) is illustrated over the NBS data (5.6 meV FWHM). A direct comparison of S(Q,ω) (in arb. units) for IXS and NBS is shown in Fig. 1. Extraction of the phonon dispersion curves from the peak positions in S(Q,w) for the glass is in progress.

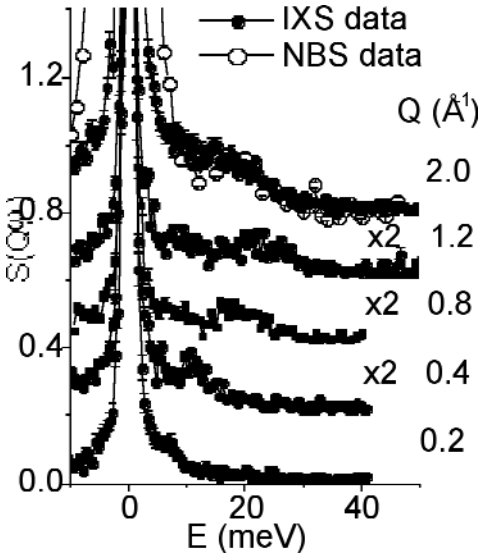

FIG. 1. X-ray dynamic structure factor, $S_X(Q,\omega)$, compared to the neutron dynamic structure factor, $S_N(Q,\omega)$, at Q=1.2Å^{-1}.

Acknowledgment

Support for this work from SRI-CAT and the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under Contract No. W-31-109-ENG-38 are gratefully acknowledged.