Nuclear resonant scattering study of quasicrystal i-AlCuFe

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Nuclear resonant scattering (NRS) of synchrotron radiation is considered a new probe in non-crystalline materials (liquids, glasses, and quasicrystals) research because the method has the possibility to obtain the vibrational character of the local environment of the resonant nucleus. Thus, it combines the inelastic neutron scattering (INS) with the contrasting scattering cross sections of neutron leading to a determination of the partial vibrational density of states (VDOS). In this letter, we report the total and partial VDOS spectrum of a i-$Al_{62}Cu_{25.5}Fe_{12.5}$ quasicrystal.

The NRS experiments were carried out at BL09XU undulator beam line at SPring-8. The high-resolution monochromator uses asymmetric silicon (511) and asymmetric silicon (975) reflections. The energy of the incident radiation was tuned by rotating the (975) channel-cut crystal in steps of 2 meV. The X-ray-weighted total VDOS was obtained by the inelastic X-ray scattering (IXS) using a resonance detector consisted of an avalanche photodiode (APD) covered by a foil of the resonant ^{57}Fe isotope, while the partial VDOS on Fe atoms was obtained by the NRS from ^{57}Fe in the quasicrystalline sample.

The X-ray-weighted total and Fe-related partial VDOS, G(E), for i-$Al_{62}Cu_{25.5}Fe_{12.5}$ quasicrystal are shown in Fig. 1, compared to the earlier neutron study [1]. The figure is illustrating that the determination of the partial VDOS will be allowed by the combination with the IXS, NRS and INS experiments.

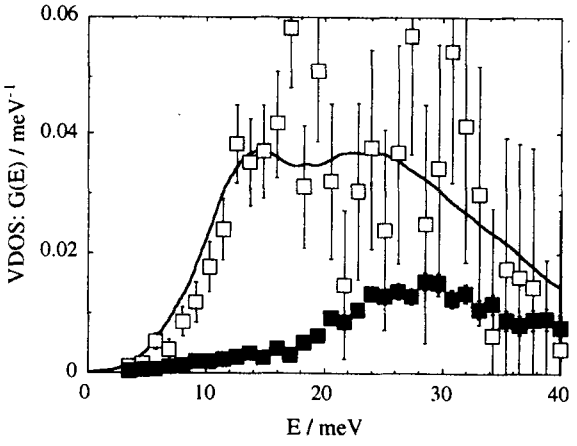

Fig. 1. Comparison of the VDOS of i-$Al_{62}Cu_{25.5}Fe_{12.5}$ quasicrystal obtained with IXS (X-ray-weighted total, open squares), NRS (Fe-related partial, closed squares) and INS (neutron-weighted total, solid line).

Reference

[1] T. Klein et al., J. Non-Cryst. Solids 188 (1995) 63