An inelastic x-ray scattering study for the origin of the strengthening mechanism on a Mg-based alloy with a long-period stacking ordered phase

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Mg is light-weighted rather than Al and can be taken from an inexhaustible resource of sea water, but cannot be used for structural materials due to the soft and flammable natures. However, Kawamura et al. [1] found a new Mg alloy of strengthened and non-flammable by adding a rare-earth metal (Y or Gd) and Zn etc. Then, these Mg alloys achieved much attention for applications as light-weighted structural materials for bodies of subways or even aircrafts. The excellent mechanical properties of the Mg alloys are believed to be highly related to the existence of Zn6Y8 L12 clusters. In this study, inelastic x-ray scattering (IXS) experiments were performed to search for how the impurity atoms produce the strong mechanical properties, by which atomic vibrations were observed and elastic properties of impurity clusters and host Mg atoms were carefully investigated [2].

Figure shows the dispersion relations obtained from the IXS spectra in the directions (a) and (b) perpendicular and (c) parallel to the *c* axis. In the figures, circles and triangles indicate the longitudinal and transverse excitations, respectively. These dispersion relations of the Mg alloys are very similar to those of pure Mg alloys indicated by the solid curves, and the dispersive excitations seem to have no impurity effects. Clear impurity effects are observed as dispersion-less excitations appeared at 5, 10, and 17 meV indicated by dashed lines. It was confirmed from a theoretical calculation that the 5 and 10 meV signals originate from the intra-vibrations of Zn_6Y_8 clusters, and the 17 meV from those between the clusters and the surrounding host Mg atoms. Namely, it was found that the impurity clusters and the surrounding Mg atoms make the soft Mg metal strengthened remarkably.

The rare-earth metal of Y or Gd is a costly rare element. From the present investigation, it is clarified how the impurity atoms form the strengthened nature of Mg alloys. Therefore, the present result is expected to give a guide to search for a new Mg alloys without any rare impurities.

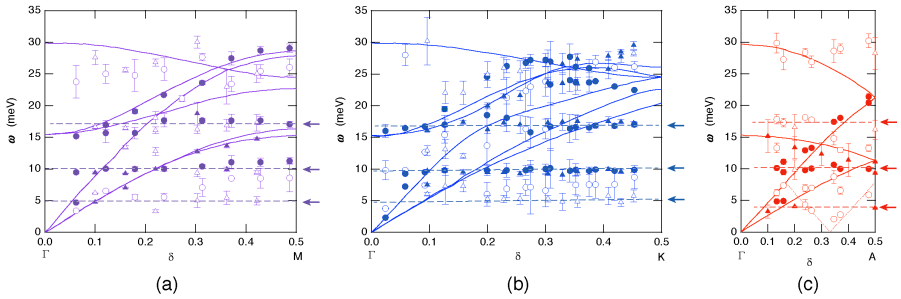

Fig. Dispersion relations in the directions (a) and (b) perpendicular and (c) parallel to the *c* axis [1].

Bibliography

[1] Y. Kawamura et al., Mater. Trans. **42**, 1171 (2001).

[2] S. Hosokawa et al.; Acta Mater., in press.

External links

http://crocus.sci.kumamoto-u.ac.jp/physics/SR/index.html