Surface Analysis of $GeMg_2$ Lump by SXPES and HAXPES

Ibuki Kawamata[1], Yuina Kanai-Nakata[1], Akinori Irizawa[2], and Shin Imada[1]

1) *Department of Physical Sciences, Faculty of Science and Engineering, Ritsumeikan University, 1-1-1 Noji-Higashi, Kusatsu 525-8577, Japan*
2) *Research Organization of Science & Engineering, Ritsumeikan University, 1-1-1 Noji-Higashi, Kusatsu 525-8577, Japan*

Surface analysis of a $GeMg_2$ lump has been performed in order to achieve basic data for a photoemission study attempting investigation of electronic properties of $GeMg_2$.

We planned to perform photoemission for a fractured sample of $GeMg_2$ in order to unveil contributions of Ge and Mg to free electrons in this compound. Free electrons in metallic materials control various properties, such as electric transport and reflectivity of electromagnetic waves. In compounds, it is not necessarily apparent whether all constituent elements supply equal numbers of electrons. It is known that anisotropic lineshape called "Doniach-Sunjic lineshape (D-S lineshape)" is found in core level photoemission of metallic materials. Therefore, element dependence of the anisotropy in D-S lineshape is considered to reflect the contributions of constituent elements to free electrons.

As a starting point of investigations outlined above, we preformed photoemission of an as-supplied lump sample of $GeMg_2$ at SA-1 of the SR Center using a scanning soft and hard x-ray photoemission spectroscopy apparatus (ULVAC-PHI Quantes). Both soft x-ray photoemission (SXPES) by Al Kα emission (1486.6 eV) and hard x-ray photoemission (HAXPES) by Cr Kα emission (5414.7 eV) has been performed on the same sample.

Figure 1 shows the Ge 2p core-level spectra measured by SXPES and HAXPES. The Ge $2p_{3/2}$ and $2p_{1/2}$ peaks of SXPES, the probing depth of which is roughly 1.5 nm, are located near to those of oxidized Ge. In HAXPES, whose probing depth is roughly 5-10 nm, additional peaks are observed at the positions similar to pure Ge. These results indicate that Ge atoms are oxidized near the surface of the lump sample of $GeMg_2$ but are not oxidized in the bulk region probed by HAXPES.

Figure 2 shows the Mg 1s core-level spectra measured by SXPES and HAXPES. The Mg 1s peak is of single peak in both SXPES and HAXPES. However, in the shape near the peak top is much sharper in SXPES than in HAXPES. These results suggest that Mg 1s HAXPES consists of two peaks with binding energies roughly 1 eV apart. Therefore, Mg atoms are expected to be oxidized near the surface of the lump sample of $GeMg_2$ but are not oxidized in the bulk region probed by HAXPES.

In summary, an as provided $GeMg_2$ lump has been investigated by Ge 2p and Mg 1s core-level photoemission by means of SXPES and HAXPES. The results suggest that the surface region of the sample was oxidized but the bulk region probed by HAXPES was not oxidized. HAXPES of *in-situ* cleaved sample is needed for further discussion.

References

[1] S. Doniach and M. Sunjic, *J. Phys. C* **1970**, *3*, 285.

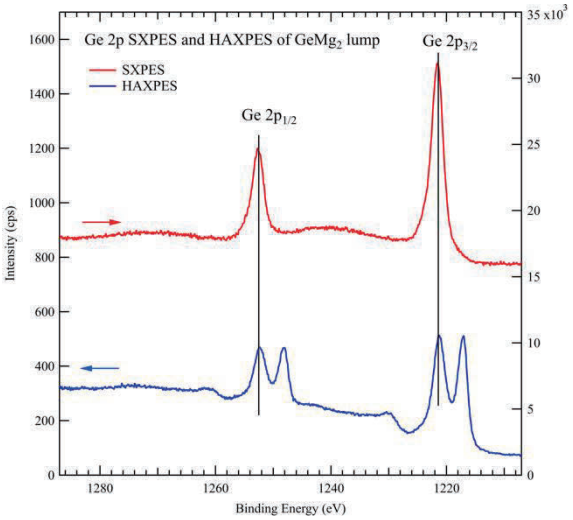

Fig. 1 Ge 2p photoemission of a $GeMg_2$ lump measured by SXPES and HAXPES. The vertical lines are guides for eyes.

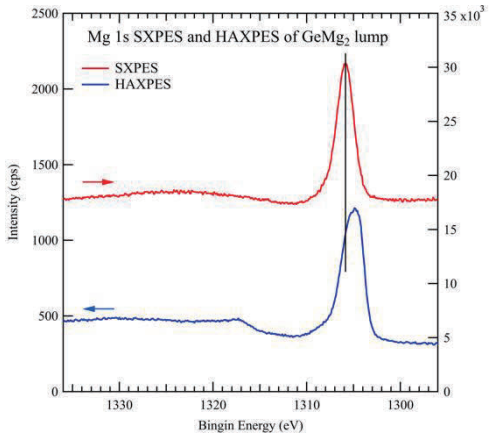

Fig. 2 Mg 1s photoemission of a $GeMg_2$ lump measured by SXPES and HAXPES. The vertical line is a guide for eyes.