Chemical state analysis of metal ions adsorbed graphene oxide

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Graphene oxide (GO) has attracted attention as adsorption material in recent years, especially an efficient adsorbent for radioactive material and metal. The adsorption of material is performed chemically [1]. So far, the chemical states of GO have been well studied and revealed that the existence of the functional groups such as epoxy, carboxyl, hydroxyl, and carbonyl groups [2,3]. Since X-ray absorption fine structure (XAFS) measurements are powerful tools, we have investigated the chemical states of the functional groups after metal ion adsorption.

GO was formed on a sapphire substrate in this study. The details are described in ref [1]. Then, GOs were dipped into a 0.1 mol/l CsCl, KCl, and $SrCl_2$ solutions for Cs, K, and Sr adsorptions, respectively (GO-Cs, GO-K, and GO-Sr). XAFS measurements were performed at the BL-8 of SR Center, Ritsumeikan University, equipped with a grazing incidence monochromator with a varied-line-spacing plane grating. Carbon and oxygen *K*-edge XAFS spectra of the samples were measured in partial electron yield (PEY) by a micro-channel plate detector with retarding grids set to -150 V and -350 V, respectively. The incident angle of SR with respect to the surface normal was varied. The measurements were performed at room temperature under the ultrahigh vacuum of ~1×10^{-7} Pa. No surface treatment was performed.

In the C *K*-edge spectra (Fig. 1), the structures around 288 eV assigned to the C = O bond [4] are similar for GO-Cs and GO-K. However, this structure is different for GO-Sr, maybe due to the different valence of the substance.

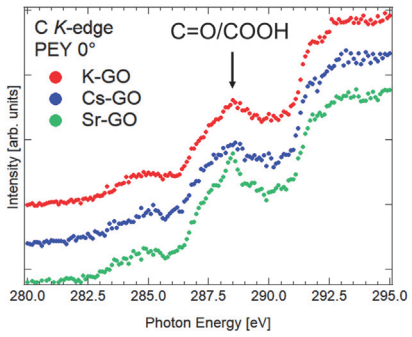

Fig. 1 C *K*-edge XAFS spectra for each adsorption of GO. K-GO (red), Cs-GO (blue), Sr-GO (green).

In the O *K*-edge spectra (Fig. 2), the peak positions around 532 eV assigned to O = C bond [5] are different for monovalent (K, Cs) and divalent (Sr). From the results of XAFS C *K*-edge and O *K*-edge, peaks representing O = C bonds showed different behavior for monovalent and divalent metals [2,6,7]. It is considered that the monovalent metal was adsorbed by ion exchange with the hydrogen of the hydroxy group. Therefore, it is considered that the monovalent metal is adsorbed using a hydroxy group or a carboxy group. It is considered that a divalent metal is adsorbed by a bonding method different from monovalent.

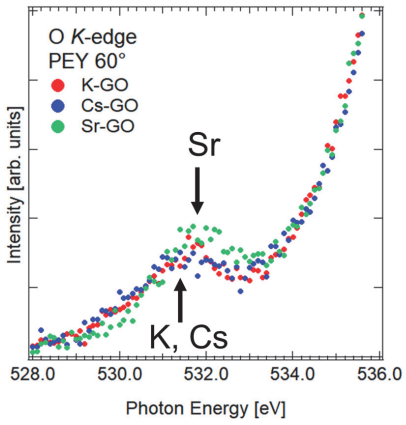

Fig. 2 O *K*-edge XAFS spectra for each adsorption of GO and GO before adsorption. K-GO (red), Cs-GO (blue), Sr-GO (green), GO (orange).

References

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