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Local Structure of Au Nanoparticles in Ionic Liquids

Yoshikiyo HATAKEYAMA[1], Satoshi TAKAHASHI[1], Kiyotaka ASAKURA[2], Keiko NISHIKAWA*[1]
[1]Graduate School of Advanced Integration Science, Chiba University, Chiba 263-8522, Japan
[2]Catalysis Research Center, Hokkaido University, Sapporo 001-0021, Japan

Introduction

Sputter deposition technique provides extremely clean method to synthesize Au nanoparticles in ionic liquids without any stabilizing agents [1]. We have investigated the control factor for the size of Au nanoparticles prepared by this method. In this method, the length of alkyl chain of cation and the temperature of ionic liquids have a big role [2-4]. Especially, the temperature is important to control the size of Au nanoparticles. Consequently, we could prepare the Au nanoparticles with well-defined sizes.

In this study, Au L_3 XAFS measurements were carried out for the investigation of the local structure of Au nanoparticles. From the EXAFS oscillation of Au L_3-edge, we extracted Au-Au bond length and coordination number. Especially, we focused on the relation between the size of nanoparticles and Au-Au bond length.

Experimental

Au nanoparticles of various sizes were prepared by sputter deposition method onto ionic liquids. Sputter deposition was carried out under the condition of 20 mA(emission), 1000 V(acceleration voltage), 16 Pa(Ar), and 20–80°C. Their sizes were determined by small angle X-ray scattering in our laboratory.

XAFS spectra of synthesized Au nanoparticles were measured by a transmission method at room temperature. EXAFS analysis was carried out using REX 2000 with a standard sample of Au foil.

Results and Discussion

Fig. 1 shows EXAFS oscillations of samples and Au foil. The amplitude and periodic structure of nanoparticles are different from those of Au foil. It is apparent that smaller particles are prepared at lower temperature. These results are consistent with the sizes determined by small angel X-ray scattering.

Furthermore, Au-Au bond lengths are plotted against their particle sizes in Fig. 2. We also plot the parameters of thiol capped particles and the particles synthesized on Mylar [5, 6]. From the comparison of them, it is confirmed that the interaction of Au nanoparticles and ionic liquids is weaker than that of thiol groups. This tendency is also observed from UV-Vis spectroscopic analysis.

At the present stage of our study, it is concluded that the interaction between Au nanoparticles and ionic liquids are weak. We also have interest in its electron structure for our next stage.

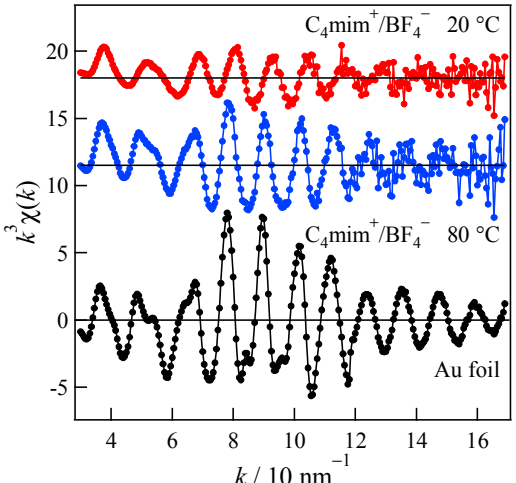

Fig. 1 EXAFS oscillations of Au nanoparticles in ionic liquids and Au foil.

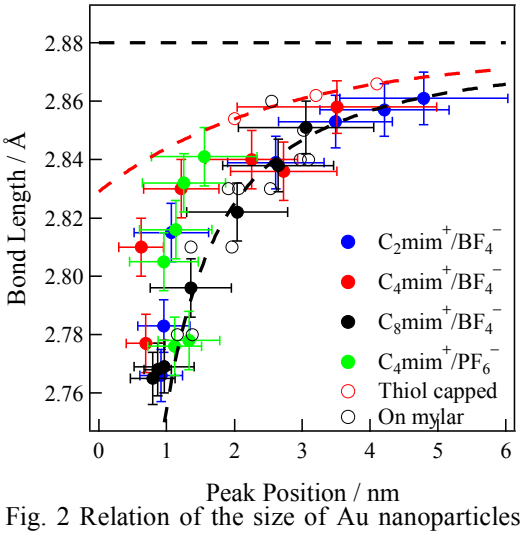

Fig. 2 Relation of the size of Au nanoparticles and Au-Au bond length.

References

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* k.nishikawa@faculty.chiba-u.jp