Colloidal Composite of Hydroxylated Fullerenes and Gold Nanoparticles

Ken Kokubo, Nozomi Sato, Mark K. E. Cabello, Hidehiro Sakurai

Division of Applied Chemistry, Graduate School of Engineering, Osaka University, 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan

E-mail: *hsakurai@chem.eng.osaka-u.ac.jp*

Since bare gold nanoparticles are unstable, they have to be stabilized by protecting with ligands, stabilizing with polymers or immobilizing on solids. Properties of gold nanoparticles depend on the design of their protecting ligands. Fullerene C_{60}, a polyhedral carbon allotrope, possesses unique physical and chemical properties such as electron accepting character, high reactivity to radical species, low electrical conductivity, high thermal stability and so on, therefore utilization of fullerene derivatives to metal particles might be interesting, indeed, there are some reports on Au nanocomposites with C60. In order to prepare the colloidal dispersion of the Au and fullerene composites, soluble fullerene derivatives should be used. We have developed a series of polyhydroxylated fullerenes, $C_{60}(OH)_n$, and among them, $C_{60}(OH)_{36}$ exhibits high water solubility up to 58.9 mg/mL and high dispersion on a molecular level.

Au:$C_{60}(OH)_{36}$ was synthesized by reduction with an excess amount of $NaBH_4$ from $HAuCl_4$ aqueous solution in the presence of $C_{60}(OH)_{36}$. The colloidal particles are homogeneously dispersed in water and are stable for months. Its core size (measured by Transmission Electron Microscope) and colloid size (measured by Induced Grating Method) are 3.7 nm and 12.2 nm, respectively. X-rays photoelectron spectroscopy (XPS) and X-ray absorption spectroscopy (XAS) measurements revealed that the nanogold is negatively charged in total, but rather positively charged on the surface due to the interface interaction with $C_{60}(OH)_{36}$.

In this presentation, the catalytic activity of the thus-prepared gold nanoparticles will also be discussed.

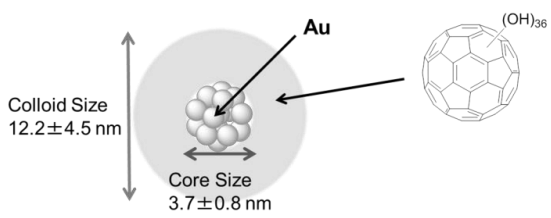

Fig. 4 Image of Au:$C_{60}(OH)_{36}$

Table 1 Electronic Properties of Au:$C_{60}(OH)_{36}$

	Core Size [nm]	Binding Energy of Au4$f_{7/2}$ [eV][a]	M-M [Å][b]	ΔE [eV][b]
Au:$C_{60}(OH)_{36}$	3.7	84.08±0.10	2.849	-0.457
Au:PVP(K-30)	2.7	83.84±0.15	2.795	-0.247
Au foil	—	84.00	2.880	0

(a)XPS(b)XANES