FABRICATION OF Fe-Pt AND AU MONODISPERSED NANOPARTICLE COLLOIDS BY KrF EXCIMER LASER IRRADIATION

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In recent years, lots of research works have been devoted to Fe-Pt alloy nanoparticles due to their diverse potentials such as ultra-high density magnetic recording[1] and biomedical uses[2]. A synthesis technique based on thermal decomposition and chemical reduction of metal complexes has been mainly applied[3], while from the complexity of process and the toxicity of iron complex, more simple and enviornmental process has been expected. In this work, we propose a synthesis technique in which nanoparticles can be easily prepared only by ultraviolet laser irradiation to precursor solutions. This technique has also been applied for synthesis of Au nanoparticles with wide-ranged applications.

A schematic diagram of the experimental configuration for laser irradiation is shown in Fig. 1. A KrF excimer pulsed laser generation system (λ = 248nm) was used as the laser light source. The conditions of laser power, pulse frequency and irradiation time were varied up to 30W, 50Hz and 60min, respecviely. The precursor solutions were methanol (Fe-Pt) and water (Au) solutions into which iron (III) and platinum (II) acetylacetonates for Fe-Pt and hydrogen tetrachloroaurate (III) hydrate for Au, respectively. Polyvinylpyrrolidone (average molecular weight ~10,000) were added to the solutions for preventing aggregation. After laser irradiation, the resulting solutions were centrifuged for the Fe-Pt and Au cases and dissolved into hexane for removal of decomposed or undecomposed matters for the Fe-Pt case.

Figure 2 shows the typical bright field transmission electron microscopic (TEM) image of the Fe-Pt nanoparticles with laser conditions of 15W and 30min using a Hitachi HF2000 with an acceleration voltage of 200kV. Very fine nanoparticles with the diameters of 1-3nm have been observed. Lattice fringes characteristic of crystallinity can be partly observed on the naoparticles. Fine nanoparticles with the same size range were always obtained independent of the laser and/or precursor conditions. Micro energy dispersive Xray spectroscopic (EDXS) measurements were carried out on the Fe-Pt nanoparticles, which indicates the alloying of iron and platinum in the nanoparticles. Irradiated laser power dependence of evaluated Fe compositions in the nanoparticles is shown in Fig.3. The lower laser power is found to cause a lower iron composition, which may indicate that the iron complex in precursor solution is harder to be decomposed compared with the platinum one. Figure 4 shows absorption spectra in ultraviolet and visible light regions for the Au nanopaticle colloids with varying laser pulse frequency. The absorption peaks characteristic of surface plasmon resonance on gold nanoparticles were observed at the wavelengths of 530-540nm. The higher pulse frequency of 20Hz is found to cause broadening in the resonance peak, considered to be due to some microstructual change.

We succeeded in fabricating Fe-Pt alloy and Au nanoparticles monodispersed in methanol or water solutions only by UV laser irradiation to precursor solutions. The further results will be discussed in the session.

References:

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[2] R.Hong, N.O.Fischer, T.Emrick and V.M.Rotello, Chem. Mater. **17** (2005**)** 4617.
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Figures:

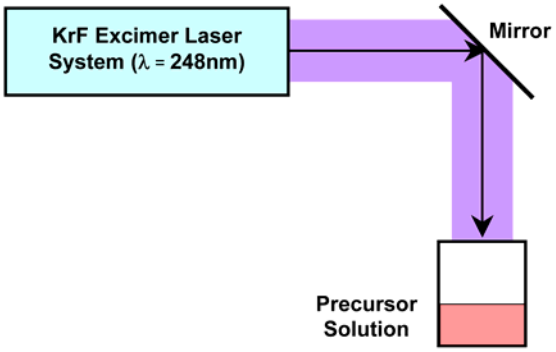

Fig.1. Schematic diagram for nanoparticle fabrication by KrF excimer laser irradiation to precursor solution

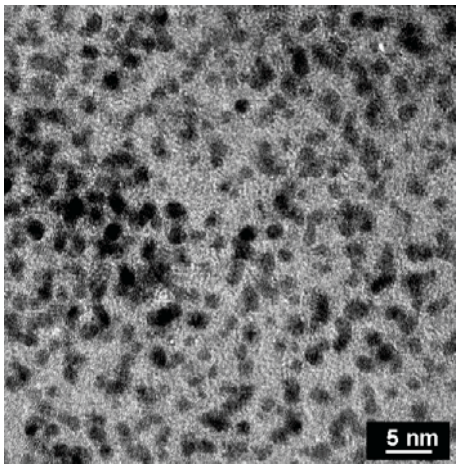

Fig.2. Transmission electron microscopic image of the Fe-Pt nanoparticles with the laser conditions of 15W and 30min.

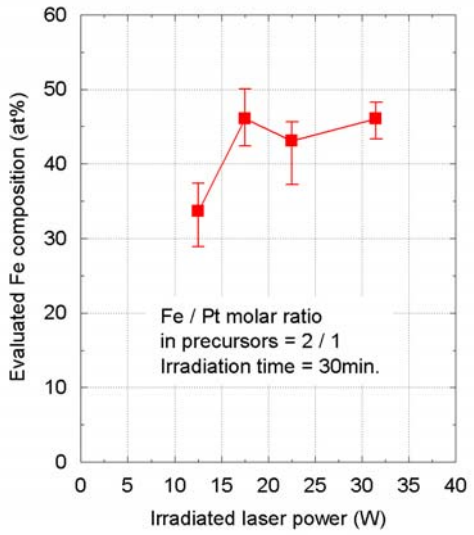

Fig.3. Irradiated laser power dependence of evaluated Fe compositions in the Fe-Pt nanoparticles

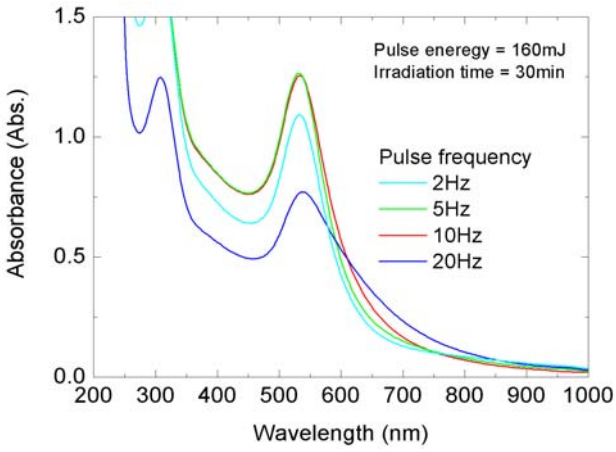

Fig.4. Ultraviolet and visible light absorption spectra of the Au nanoparticles with varying pulse frequency.