



논문개요집

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The Korean Magnetics Society

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Mössbauer studies on core-shell $\text{Fe}_{1.5}\text{@Pt/C}$ nanoparticles post-heated in NH_3 gas atmosphere

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$\text{Fe}_{1.5}\text{@Pt/C}$ core-shell is used as an electrode catalyst for fuel cells, and research has been conducted to reduce costs and improve performance for application to fuel cells. In this study, the structural and magnetic properties of the $\text{Fe}_{1.5}\text{@Pt/C}$ core-shell heat treated in an NH_3 gas atmosphere were investigated.

The $\text{Fe}_{1.5}\text{@Pt/C}$ core-shell was prepared using the sonochemical method. $\text{Fe}(\text{acac})_3$, $\text{Pt}(\text{acac})_2$, and carbon support (Vulcan XC-72R) were dispersed in ethylene glycol. The mixture was placed in a girb0type sonicator and then it was irradiated over 3 h. To remove residual ethylene glycol, the obtained black slurry was filtered and washed with ethanol and DI water. The sample was dried in a vacuum oven at 70 °C for 12 h. Then, the post-heat treated $\text{Fe}_{1.5}\text{@Pt/C}$ samples in an NH_3 gas atmosphere were annealed at 510 °C for 2 h. To remove iron oxides and other residues from the heat-treated sample, the sample was acid-treated in 0.1M HClO_4 at 85 °C for 2 h. In order to obtain a clear core-shell structure, the sample was additionally annealed at a temperature of 300 °C in an H_2/N_2 atmosphere for 2 h. And finally, $\text{Fe}_{1.5}\text{@Pt/C}$ with a core-shell structure was obtained. The sample was denoted as $\text{Fe}_{1.5}\text{@Pt/C_NH}_3$.

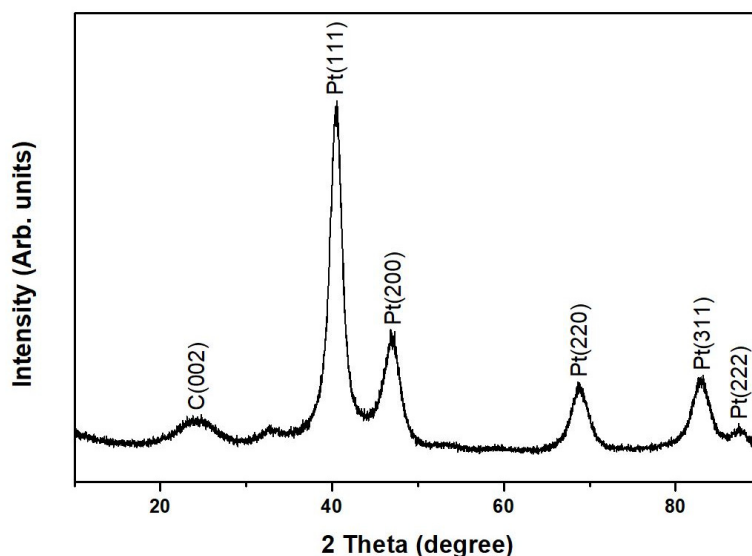


Fig. 1. XRD patterns of $\text{Fe}_{1.5}\text{@Pt/C_NH}_3$

The crystallographic properties and core-shell structure of the $\text{Fe}_{1.5}\text{@Pt/C_NH}_3$ core-shell were confirmed through X-ray diffraction (XRD), transmission electron microscopy (TEM), and scanning transmission electron microscopy–energy dispersive spectroscopy (EDS). In addition, in order to investigate the magnetic properties of

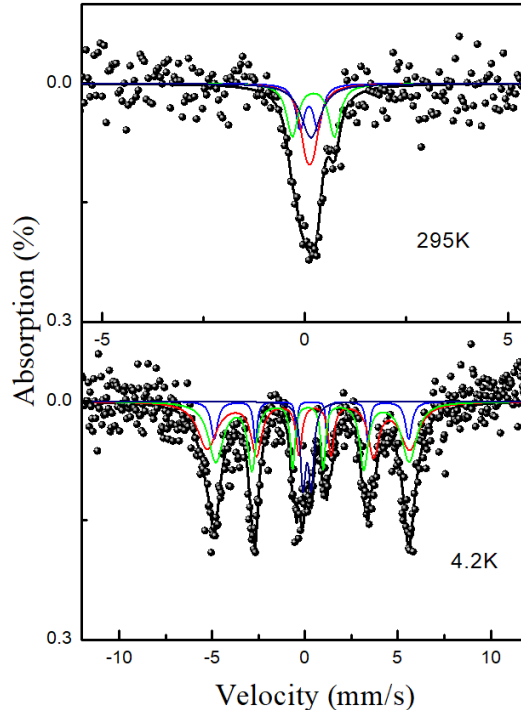


Fig. 2. Mössbauer spectra of $\text{Fe}_{1.5}@\text{Pt/C_NH}_3$ at 4.2 and 295K

the sample, the Mössbauer spectra were observed at 4.2 and 295 K and the M-H curve was measured using a vibrating sample magnetometer (VSM). Pt peaks were confirmed from the XRD patterns and the average crystallite sizes of the sample was confirmed to be 4.9 ± 1.4 nm using TEM image. The EDS line profile of $\text{Fe}_{1.5}@\text{Pt/C_NH}_3$ revealed a core-shell structure with a Pt skin layer (0.3 nm). The saturation magnetization and coercivity at 295 K were 7.1 emu/g and 134.5 Oe, respectively. The Mössbauer spectrum of the $\text{Fe}_{1.5}@\text{Pt/C_NH}_3$ at 295 K were analyzed with 4 sets of doublets and the electric quadrupole splitting (ΔE_Q) values were $\Delta E_{Q,1} = 0.44$ mm/s, $\Delta E_{Q,2} = 0.17$ mm/s, $\Delta E_{Q,3} = 1.04$ mm/s, and $\Delta E_{Q,4} = 0.07$ mm/s, respectively. Also, the spectrum at 4.2K was measured with 3 sets of sextet and one doublet and the magnetic hyperfine field (H_{hf}) values were analyzed as $H_{\text{hf},1} = 325.2$ kOe, $H_{\text{hf},2} = 339.7$ kOe, and $H_{\text{hf},3} = 323.6$ kOe, respectively. From the isomeric shift values, all Fe valence states was determined to be ferric.