A study on electrochemical property of Pt nanoparticles on polyethyleneimine-decorated graphene

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Recently, many studies for graphene modification are researched to improve electrochemical activities and capacity for electrode materials. These materials could be applied to electrical devices, electric vehicles and various batteries. Moreover, developed energy storehouse and energy convertors are contributing to green energy system. In green energy system, various carbon sources such as carbon black, carbon nanotubes, graphene, fullerene and carbon nanofibers are used in conductive materials [1, 2]. Among them, graphene is interested because of huge theoretical surface area (calculated value, 2630 m^2/g), high electrical conductivity (10^3~10^4 S/m), lightweight, plate structure and potentially low manufacturing costs [3].

However, pristine graphene has some critical disadvantages to use as electrode materials. Graphene doesn't have functional groups after reduction that occur aggregation of graphene sheets in water system. In addition, irregular functional groups work to active sites which induce random chemical deposition on graphene surface [4].

For these reason, we synthesize polyethyleneimine (PEI) covered graphene as Pt electro-catalysts in fuel cells. Complex structured precursors and graphene surface could have given repulsive forces because of anionic complex structure and negative charged functional groups, respectively. In addition, these properties could give uniform distribution, regular particle diameter and high level of reduction to graphene supported catalysts.

Electrochemical measurements were performed by standard 3-electrode cells. The potential range of cyclic voltammograms (CV) was measured from -0.3 V to 1.2 V in 0.5M H_2SO_4 at a scan rate of 50 mV/s. Figure 1 shows the CV curves for (a) Pt/graphene and (b-d) Pt/PEI-graphene. Pt/PEI-graphene shows the higher current density than Pt/graphene. From the results, it could be concluded that the PEI-decorated graphene provide the better electrocatalytic activity.

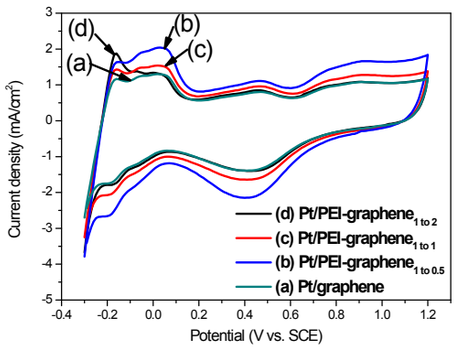

Fig. 1 Cyclic voltammograms for (a) Pt/graphene and (b-d) Pt/PEI-graphene in 0.5M H_2SO_4 at a scan rate of 50mV/s.

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