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Characteristic of Palladium as Cathode Catalysts for Oxygen Reduction Reaction on DMFC

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Oxygen reduction reaction (ORR) in DMFC is very slow and undergoes through several different reaction pathways. Its kinetics and mechanism were widely investigated primarily on the surface of platinum (Pt). Due to its costly price, much effort was invested to enhance its catalytic activity, either by preparing it to nano-size particle, or by alloying it with less noble metal. Palladium (Pd) possesses a similar valence electronic configuration and lattice constant to Pt and is tolerant to methanol contamination. Recently, Pd-based alloys have been reported to be ORR catalyst with excellent methanol tolerance. The tolerance is important to DMFCs, because methanol permeating through the electrolyte membrane from anode is oxidized on ORR catalysts at the cathode, and thus voltage as well as fuel-efficiency is degraded. H. Li obtained that palladium-rich Pd_3Pt_1/C catalyst enhanced DMFCs cathode performance for its selective ORR activity in the presence of methanol and may be an alternative methanol tolerant cathode on DMFCs. We also reported that the Pd catalyst as cathode material showed comparable performance to Pt catalyst for ORR in DMFC.

In our study, to improve the catalytic activity of the Pd, we synthesized the Pd-metal oxide (MO_x) nanoparticles supported on carbon black (Pd-MO_x/C) by adding metal oxide nanoparticles to Pd/C and evaluated for ORR by electrochemical method. Thus, we selected the nano-sized titanium dioxide (TiO_2) as transition metal oxide because this material is stable in acid condition. The nature and function of titanium dioxide in the catalyst were analyzed by TEM, XRD, EDS, CV, fuel cell test etc. Detail results will be discussed more at conference.