PtRu nanophase in WO_x for direct methanol fuel cell electrode prepared by nanoparticle synthesis and multigun sputtering system

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Thin-film fuel cells (TFFCs) have been of interest as power sources ranging from small digital devices to micro-electromechanical systems because of small-sized for on-chip or integration as well as capability to operate the devices. In general, the electrodes in fuel cells consist of more than two phases such as nano-size noble metals such as Pt and porous materials as a support for the metals. In addition, Pt-based alloy nanostructure, especially, formed by alloying Pt and Ru, is a requisite for highly efficient TFFCs, modulating composition Pt and Ru in the electrodes. That is, the electrodes for an excellent current density in TFFCs should have PtRu alloyed nanophase in porous material. However, typically, sputtering methods have been used for thin-film electrodes without any nanostructure prepared by the PtRu alloy target with a fixed composition. However, such conventional sputtering techniques with one sputtering target of a mixed two-phase material cannot be used to provide alloy nanostructured electrodes having alloy catalysts with controlled composition and porous oxides. Accordingly, nanostructured alloy electrodes for TFFCs were fabricated using multi-guns sputtering system consisting of metal targets of Pt and Ru for alloy formation and oxide target of WO_3 for nanophases formation.

We suggested alloy nanostructured electrode for use in high efficient TFFCs using multi-gun sputtering system, compared to conventional PtRu alloy electrode. The alloy nanostructured electrode showed excellent current density for the TFFC, due to the alloy formation of Pt-Ru and nanophases in tungsten oxides.

References

[1] Park, K.-W.; Ahn, K.-S.; Choi, J.-H.; Nah, Y.-C.; Kim, Y.-M.; Sung, Y.-E. *Appl. Phys. Lett.* **2002**, *81*, 907.

[2] Park, K.-W.; Ahn, K.-S.; Choi, J.-H.; Nah, Y.-C.; Sung, Y.-E. *Appl. Phys. Lett.* revised **2002**.

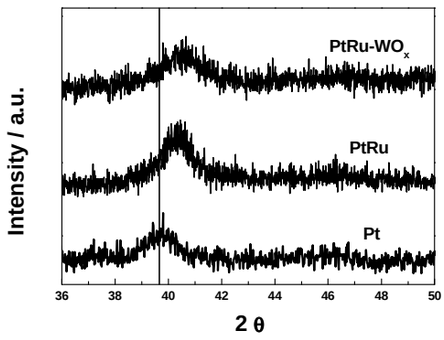

Figure 1. XRD patterns of Pt, PtRu, and PtRu-WO_x deposited using sputtering or a multi-gun sputtering system. (The vertical solid line indicates original peak position of pure Pt in XRD pattern.).

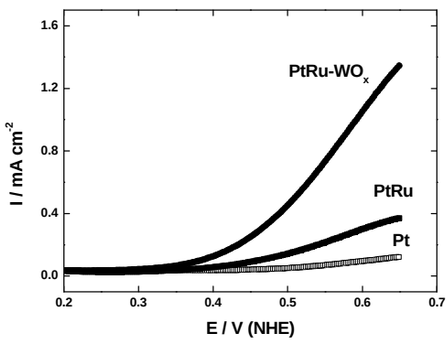

Figure 2. Methanol electrooxidation current density *vs*. potential for the PtRu-WO_x nanostructured alloy electrode, PtRu, and Pt electrode.