Comparison of Pt/Ni nanoparticles and thin-film electrodes for methanol electrooxidation

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Pt/Ni thin-film electrodes were fabricated by e-beam evaporation of metal layers and rapid thermal annealing (RTA) for alloy formation between Pt and Ni layers. The structural, chemical, and electronic properties of the thin-film electrodes annealed at 200, 300, 500 ^{o}C were classified as the follows: Pt-dominant (as-Pt/Ni or 200 ^{o}C Pt/Ni), Pt-based (300 ^{o}C Pt/Ni) and Ni-dominant (500 ^{o}C Pt/Ni). The Pt/Ni thin-film electrodes could be matched well with Pt/Ni nanoparticles such as Pt/Ni(3:1), (1:1), and (1:3) synthesized by chemical method with a variety of compositions. The modified electronic properties of platinum in Pt/Ni alloy catalysts as well as an excellent catalytic activity for methanol electrooxdation were attributed to surface and bulk structure of Pt/Ni alloys with a proper composition such as 300 ^{o}C Pt/Ni thin-film electrode and Pt/Ni(1:1) nanoparticle, correlating the characteristics of film and nanoparticle based on the XRD, AES, and XPS analysis. Finally, we expect that the electrodes designed by thin-film processing such as e-beam evaporator and RTA system will be used in the systematic approach to characterization of alloy nanoparticles.

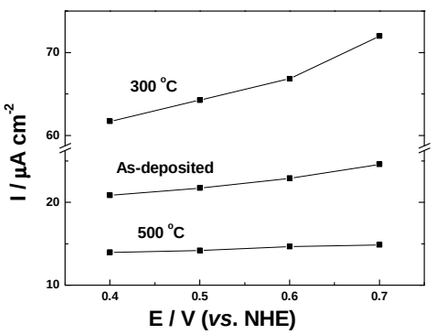

Figure 1. Plot of methanol electrooxidation current density *vs*. potential for Pt/Ni thin-film electrodes in 2 M CH_3OH + 0.5 M H_2SO_4.

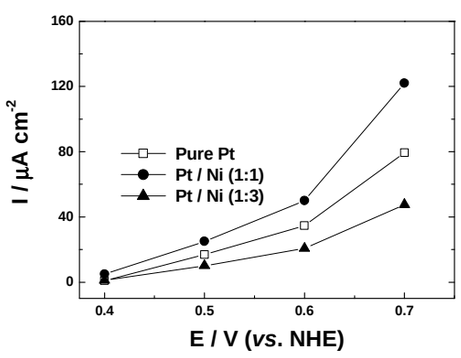

Figure 2. Methanol electrooxidation current *vs*. potential in 2 M CH_3OH + 0.5 M H_2SO_4 of Pt/Ni nanoparticles synthesized by borohydride reduction.

References

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