Preparation of Dealloyed Catalysts with Durably High Oxygen Reduction Activity

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Pt-alloy catalysts have attracted much attention because of their high activity for the oxygen reduction reaction compared to that of pure Pt catalysts. One variant of the Pt-alloy catalyst is the "dealloyed catalyst" made by first preparing an alloy precursor with a high base-metal-to-Pt ratio (≥1:1) and then removing most of the base metal, resulting in Pt-rich particles (M:Pt of ~1:3).[1] Removal of the base metal (dealloying) by electrochemical voltage cycling or by acid leaching can result in a particle with Pt-rich skin covering a base-metal-rich core. It was suggested that lattice mismatch between the two layers induced strain in the surface Pt shell[2] and that the near-surface structure was a driven factor in determining the initial activity[3]. While high initial activities (4-6 fold of Pt/C) were achieved for dealloyed catalysts in fuel cells, durability had posed more of a challenge.[4]

In this talk we will highlight many factors in the dealloying process that have been shown to affect not only the initial activity but also the durability of the resulting catalysts in fuel cells. The factors include dealloying temperature, time, acid type, catalyst-precursor type, and post-dealloying thermal annealing. Multiple catalysts prepared in this study were shown to satisfy Department of Energy targets both initial activity and durability. The sensitivity of the durability to the particle microstructure will also be discussed.

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References

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