Facile Preparation of Ordered Intermetallic Nanostructures for High Performance Fuel Cell Catalysis

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Ordered, large pore (> 30 nm) mesoporous carbon/silica (OMCS) composites with well-dispersed intermetallic PtPb on pore wall surfaces was synthesized through the one-pot synthesis. The resulting material exhibited high performance as an anode catalyst for direct formic acid fuel cells (DFAFCs). The final materials have a two-dimensional (2-D) hexagonal type structure. Uniform and large pores, in which intermetallic PtPb nanocrystals are significantly smaller than the pore size and highly dispersed enable pore backfilling with ionomer and formation of the desired triple phase boundary (TPB) in single cells. The materials show more than 10 times higher mass activity and significantly lower onset potential for formic acid oxidation as compared to commercial Pt/C, as well as high stability due to better resistivity toward CO poisoning. In single cells, the maximum power density was higher than that of commercial Pt/C, and the stability highly improved, compared with commercial Pd/C. The results suggest that PtPb based catalysts on large-pore OMCSs may be practically applied as real fuel cell catalysts for DFAFC. We have developed simple and scalable method to synthesize supportless intermetallic fct-FePt NTs by using coaxial electrospinning method. MEAs fabricated using the synthesized nanotubes exhibited the comparable performance as compared to Pt/C. Furthermore, fct-FePt NTs showed no significant change of morphology and charge transfer resistance after ADT performed at a potential of 1.4 V, suggesting that the catalysts have high stability at local hydrogen starvation conditions.

[1] J. Lee *et al. ACS nano*, **2012**, *6*, 6870