Block Copolymer directed Synthesis of High Performance PtPb Nanocatalysts in Ordered Mesoporous Carbon/Silica toward Direct Formic Acid Fuel Cell Anodes

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Here, we report on the facile synthesis of well-dispersed intermetallic PtPb nanoparticles in an ordered mesoporous carbon/silica composites by employing an amphiphilic diblock copolymer assisted co-assembly of hydrophobic metal precursors and hydrophilic carbon and silica precursors. 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. This novel material shows a mass activity that is more than 10 times higher and an onset potential for formic acid oxidation that is much lower than that of commercial Pt/C as well as high stability due to better resistivity toward CO poisoning. Furthermore, the large 2-D hexagonal pores provide effective transport of fuels to the intermetallic nanocatalysts, resulting in good performance of the material as an anode catalyst for direct formic acid fuel cell (DFAFC).