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TITLE: Nanoscale Dendritic Platinum Catalysts for Fuel Cells.

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ABSTRACT: Proton exchange membrane (PEM) fuel cells are an energy efficient and environmentally benign energy conversion technology with the potential to replace internal combustion engines and batteries in portable, stationary, and automotive applications. However, the durability and cost of fuel cell materials, especially platinum, continue to impede successful commercialization. A major factor determining the overall lifetime achieved by a fuel cell stack is the loss of active surface area of platinum-based electrocatalysts caused by the processes of oxidation, dissolution, particle migration, sintering and coarsening. Research on improving the durability of platinum electrocatalysts has focused mainly on alloying platinum with non-precious metals and supporting platinum on various electrically conductive materials, e.g., carbon black, carbon nanotubes, *etc*. An alternative approach is to nanoengineer the platinum electrocatalyst in a ripening-resistant morphology to increase its stability. Recently, we reported nanostructures composed of dendritic platinum sheets, including flat nanosheets, spherical nanocages, and foam-like nanospheres. Here, we discuss the remarkable stability of holey sheets that are formed by ripening of the dendritic sheets in PEM fuel cell experiments. We attribute the stability of holey platinum sheets to their unique morphology. In particular, the formation of persistent nanopores in the 2-nm thick sheets make them remarkably resistant to loss of surface area from surface diffusion processes. We also present Monte Carlo simulations that show this holey sheet topology is resistant to some ripening processes.

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