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Influence of Surface Treatment on Adhesion between Pt Nanoparticle and Carbon Support

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The short lifetime of Proton Exchange Membrane Fuel Cell (PEMFC) is the one of the main problems to be solved for commercializing. Especially, the weak adhesion between metal nanoparticles and supports deteriorate the performances of nanocatalysts, therefore, it is considered to be a major failure mechanism. Using force-distance spectroscopy of atomic force microscopy (AFM), we characterized the adhesion between Pt nanoparticles and carbon supports that is crucially related to the durability for membrane fuel cell (MFC) electrode. In our study, force distance curves measured with Pt coated AFM cantilever, mimicking the behavior of corresponding nanoparticles on carbon supports, leads to the adhesion between metal nanoparticles and carbon supports. We found that the adhesion between Pt and HNO₃-treated carbon is enhanced by a factor of 4, compared to Pt and bare carbon support, that is consistent with the macroscopic durability test of PEMFC. The higher adhesion between Pt and HNO₃-treated carbon can be explained in light of the stronger chemical interaction by C/O functional groups.

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