Exfoliated Pt-clay/nafion nanocomposite membrane for self-humidifying polymer electrolyte fuel cells

Monolayers of Pt nanoparticles of diameters of 2-3 nm with a high crystallinity were successfully anchored onto exfoliated nanoclay surfaces using a novel chemical vapor deposition process. Chemical bonding of Pt to the oxygen on the clay surface ensured the stability of the Pt nanoparticles, and hence, no leaching of Pt particles was observed after a prolonged ultrasonication and a rigorous mechanical agitation of Pt-clay in the Nafion solution during the membrane casting process. Systematic analysis using WAXD and TEM showed that the recasting process produced a new self-humidifying exfoliated Pt-clay/Nafion nanocomposite membrane with a high crystallinity and proton conductivity. In situ water production for humidification of the dry membranes without any external humidification was characterized by a combined water uptake and PTIR analysis of the as-prepared membrane after a single cell testing without using electrodes. The power density at 0.5 V of a single cell made of a Pt-clay/Nafion nanocomposite membrane was 723 mW/cm², which is 170% higher than that made of a commercial Nafion 112 membrane of similar thickness. No compromise in mechanical properties was observed. © 2008 American Chemical Society.