Evolution of the degradation mechanisms with the number of stress cycles during an accelerated stress test of carbon supported platinum nanoparticles

Evolution of the degradation mechanisms with the number of stress cycles during an accelerated stress test of carbon supported platinum nanoparticles

Development of high performance electrodes for polymer electrolyte membrane fuel cells (PEMFCs) requires fast screening of the catalysts for their catalytic activity and durability by subjecting them to a suitable accelerated stress test (AST). Electrochemical potential cycling in acidic media is one of such frequently used ASTs of platinum nanoparticle-based catalysts. The activity degradation of such catalysts during AST takes place through different mechanisms including particle size growth, dissolution and detachment of catalyst particles, electronic connectivity loss, etc. Here, we present a quantification of these degradation mechanisms with the number of potential cycles (N) during the AST of carbon supported platinum catalyst. Among various mechanisms, the activity degradation due to particle size growth attributed to the Ostwald ripening is found to be the most prominent during the initial part of the AST (N < 500). On the other hand, the loss due to dissolution/detachment varies linearly during the AST cycling. Such understanding of the evolution of degradation mechanisms with N may be utilized effectively towards development of high performance PEMFC electrocatalysts.