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Highly dispersed Pt nanoparticles on the novel $Ti_{0.7}W_{0.3}O_2$ support using the Rapid Microwave-Assisted Polyol Route

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EXTENDED ABSTRACT

Mesoporous $Ti_{0.7}W_{0.3}O_2$ nanoparticles, being in anatase TiO_2 phase, possessed a uniform morphology of spherical nanoparticles of 10 nm diameter with the high surface area up to 201.481 m^2/g, which is closely similar to the surface area of common commercial carbon blacks. More importantly, the electrical conductivity of $Ti_{0.7}W_{0.3}O_2$ was found to be 0.022 S/cm, which is ~ $1.0x10^5$-fold higher than that of undoped-TiO_2 ($1.37x10^{-7}$ S/cm). The increase in electrical conductivity of $Ti_{0.7}W_{0.3}O_2$ may attribute to the successful incorporation of tungsten(VI) ions into TiO_2 lattices, subsequently resulting in n-type doping and generating more free electrons acted as charge carriers. The $Pt/Ti_{0.7}W_{0.3}O_2$ catalyst also was synthesized via the rapid microwave-assisted polyol route at 160 °C for 4 min with the power of 240W. As a result, the uniformly spherical Pt nanoparticles morphology of ~ 3 nm diameter well adhered on the surface of the $Ti_{0.7}W_{0.3}O_2$ support, which could ascribe for the large surface area of mesoporous $Ti_{0.7}W_{0.3}O_2$ support enables the good distribution of Pt nanoparticles. The smaller diameter of Pt particles could be explained due to the rapid reduction of metal salts and formation of metal nuclei facilitated by the microwave, which can support fast and uniform heating of reaction mixture through dielectric losses, bringing about the rapid formation of metal nuclei in the microwave-assisted method restricts further growth of the particles initially formed. These results could be suggested that the rapid microwave-assisted polyol method is a promising method to alter conventional methods for the synthesis of $Pt/Ti_{0.7}W_{0.3}O_2$ catalyst materials.

Keywords: fuel cells, mesoporous materials, $Ti_{0.7}W_{0.3}O_2$, W-doped TiO_2, solvothermal process