Glycerol electro-oxidation to dihydroxyacetone on phosphorous-doped Pd/CNT nanoparticles in alkaline medium

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ABSTRACT

In this communication report, a comparative study between P-doped Pd/CNT and bare Pd/CNT catalyst was carried out to decouple the effects of phosphorous-doping on electro-oxidation of glycerol. The initial characterization results suggested that Pd and its oxides were successfully incorporated within the pore channels of CNTs support for both catalysts by using hydrazine-assisted hydrothermal technique. The XPS results revealed that the amount of Pd^{2+} for bare Pd/CNT were 1.4 times higher than P-doped electrocatalysts (about 70.1% and 48.7%, respectively) which confirms that phosphorus facilitates the reduction of Pd^{2+} to metallic Pd (Pd^0). The electrochemical results showed that the electrochemical surface area (392.22 $m^2\ g_{Pd}^{-1}$) and current density (26 mA/cm^2) for P-doped Pd/CNT catalyst were 2.84 and 1.6 times, respectively, higher than Pd/CNT catalyst. The P-doped catalyst was found to suppress the formation of carbonaceous intermediates; thus, improved the glycerol oxidation reaction. Small quantities of deep oxidation side products such as mesoxalic acid (<2%) and tartronic acid (<0.1%) were found along with the dihydroxyacetone (DHA), a major product of glycerol electro-oxidation. The best performing catalyst exhibited 1.4 folds higher DHA selectivity (90.8%) compared to the Pd/CNT.

KEYWORDS

P-doped Pd/CNT; Electrocatalyst; Glycerol electro-oxidation reaction; HPLC; Dihydroxyacetone

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