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CORROSION, MATERIALS AND ENVIRONMENTAL PROTECTION

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ZAŠTITE MATERIJALA I ŽIVOTNE SREDINE*

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Methanol electrooxidation on carbon-supported binary and ternary platinum catalysts

Elektrooksidacija metanola na binarnim i ternarnim platinskim katalizatorima na ugljeničnom nosaču

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Abstract

One of the most popular alternative sources of energy are direct methanol fuel cells (DMFCs) with platinum-based catalysts due to their non-toxicity, reduced emissions of hazardous pollutants and high energy density. However, significant challenges of the scientific community related to Pt catalysts are the high cost, depletable resources and formation of poisoning species i.e. CO, during the methanol oxidation reaction. To reduce the amount of expensive Pt and susceptibility of Pt to poisoning species and simultaneously improve its catalytic performance, recent studies are focusing on the synthesis of Pt alloys in which a certain amount of platinum is replaced with less expensive metals such as Ru, Sn, Ni, Cu, Rh and Co. The usage of carbon (Vulcan XC-72R) for catalyst support enables high dispersion of metal, high surface area and good electrical conductivity improving overall performances of DMFCs. In this work, PtZn/C and PtSnZn/C catalysts were synthesized by the microwave-assisted polyol method. The structure and morphology of the catalysts were characterized by transmission electron microscopy (TEM), thermogravimetric (TG) and X-ray diffraction (XRD) analysis. The activity and stability of synthesized catalysts for methanol oxidation in 0.5 M sulfuric acid were investigated. It was demonstrated that the activity of the platinum catalysts was improved thanks to the synergistic effects caused by the addition of different metals, such are bifunctional and electronic effects.

Keywords: Fuel Cell; Platinum Catalysts; Methanol electrooxidation

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Izvod

Jedan od najpopularnijih alternativnih izvora energije su gorivne ćelije sa metanolom (DMFC) koje sadrže platinske katalizatore, zbog njihove netoksičnosti, smanjene emisije zagađujućih materija i velike gustine energije. Međutim, značajni izazovi sa kojima se susreće naučna zajednica, a koji se odnose na platinske katalizatore su visoka cena, iscrpljivi resursi i formiranje ometajućih nusprodukata tokom reakcije oksidacije metanola, kao što je CO. Da bi se smanjila količina Pt u katalizatoru i osetljivost Pt na ometajuće nusprodukte, a ujedno i poboljšale katalitičke performanse katalizatora, ulažu se veliki naponi da se sintetišu legure na bazi Pt u kojima je određena količina platine zamenjena jeftinijim metalima kao što su Ru, Sn, Ni, Cu, Rh i Co. Upotreba ugljeničnog materijala (Vulcan XC-72R) kao nosača metala u katalizatoru omogućava bolju disperziju metala, veću površinu i dobru električnu provodljivost. U ovom radu, PtZn/C i PtSnZn/C katalizatori su

sintetisani polioliol postupkom pomoću mikrotalasne pećnice. Struktura i morfologija katalizatora su okarakterisane transmisijom elektronskom mikroskopijom (TEM), termogravimetrijskom (TG) i rendgensko difrakcijom (XRD) analizom. Aktivnost i stabilnost sintetisanih katalizatora u 0,5 M sumpornoj kiselini je ispitivana za oksidaciju metanola. Pokazalo se da je aktivnost platinastih katalizatora poboljšana zahvaljujući sinergetskom efektu izazvanom dodavanjem različitih metala, poput bifunkcionalnog i elektronskog efekta.

Ključne reči: *Gorivna ćelija; Platinski katalizatori; Elektrooksidacija metanola*

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