Electrochemical and Electrocatalytic Behavior of Pd-based Electrodes in Alkaline Media

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Abstract

During the late 20th and early 21st centuries, palladium began to be used in electrocatalysis as a more economical substitute for platinum, especially in situations where CO resistance, such as in fuel cells, is an essential consideration. Additionally, Pd-based catalysts, in particular when alloyed with other metals, often exhibit higher tolerance to certain poisons, a common challenge faced in polymer electrolyte membrane fuel cells (PEMFCs). The role of ethanol as the anode reaction of PEMFCs is well recognized. Key performance indicators for effective electrocatalysts in the ethanol oxidation reaction (EOR) consist of high activity (characterized by low onset potential and elevated current density), outstanding selectivity (favouring the desired products such as C1 species), and remarkable durability (ability to resist deactivation and poisoning over time). Strategies for catalyst design that enhance performance include the appropriate morphology, optimization of electronic structures through the incorporation of non-precious or transition metals, and the utilization of two-dimensional materials. Apart from catalyst design, the choice of electrolyte greatly affects the EOR by influencing mass transport, charge transfer, and the stability of reaction intermediates. In such way electrolyte engineering may be an effective method for improving performance. Recent studies on Pd and Pd-Sb catalysts have shown that the interactions between the alkaline electrolyte and the electrocatalyst have a significant impact on the electrocatalytic properties indicating that selection of the proper electrolyte also plays an active role in electrocatalytic behaviour.

Keywords: *electrooxidation of ethanol; direct alcohol fuel cells; electrodeposition; surface morphology; alkali metal cations*

Izvod

Krajem 20. i početkom 21. veka, paladijum je počeo da se koristi u elektrokatalizi kao ekonomičnija zamena za platinu, posebno u situacijama gde je otpornost na CO, kao što je u gorivnim ćelijama, bitna stvar. Pored toga, katalizatori na bazi Pd, posebno kada su legirani sa drugim metalima, često pokazuju veću toleranciju na određene otrove, što je izazov sa kojim se suočavaju gorivne ćelije sa polimernim elektrolitnim membranama (PEMFCs). Uloga etanola kao anodne reakcije PEMFC-a je poznata. Ključni indikatori za efikasne elektrokatalizatore u reakciji oksidacije etanola (EOR) obuhvataju visoku aktivnost (koju karakteriše nizak početni potencijal i povišena gustina struje), izuzetnu selektivnost (koja favorizuje željene proizvode kao što su C1 vrste) i izuzetnu izdržljivost (sposobnost da se ne deaktiviraju i ne truju tokom vremena). Strategije za dizajn katalizatora koje poboljšavaju performanse uključuju odgovarajuću morfologiju, optimizaciju elektronskih struktura kroz ugradnju neplemenitih ili prelaznih metala i korišćenje dvodimenzionalnih materijala. Pored dizajna katalizatora, izbor elektrolita značajno utiče na EOR delovanjem na transport mase, prenos naelektrisanja i stabilnost reakcionih intermedijera. Na taj način, inženjering elektrolita može biti efikasan metod za poboljšanje performansi. Nedavne studije o Pd i Pd-Sb katalizatorima pokazale su da interakcije između alkalnog elektrolita i elektrokatalizatora imaju značajan uticaj na elektrokatalitička svojstva, što ukazuje da izbor odgovarajućeg elektrolita takođe igra aktivnu ulogu u elektrokatalitičkom ponašanju.

Ključne reči: *elektrookidacija etanaola; direktno alkoholne alkalne gorivne ćelije; elektrohemijsko taloženje; površinska morfologija; katjoni alkalnih metala*

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