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Influence of Nitrogen Doping on the Catalytic Activity of Ni-Incorporated Carbon Nanofibers for Alkaline Direct Methanol Fuel Cells

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Abstract : In this study, the influence of nitrogen doping on the electrocatalytic activity of carbon nanofibers with nickel nanoparticles toward methanol oxidation is introduced. The modified carbon nanofibers have been synthesized from calcination of electrospun nanofiber mats composed of nickel acetate tetrahydrate, poly(vinyl alcohol) and urea in argon atmosphere at 750oC. The utilized physicochemical characterizations indicated that the proposed strategy leads to form carbon nanofibers having nickel nanoparticles and doped by nitrogen. Moreover, due to the high-applied voltage during the electrospinning process, the utilized urea chemically bonds with the polymer matrix, which leads to form nitrogen-doped CNFs after the calcination process. Investigation of the electrocatalytic activity indicated that nitrogen doping NiCNFs strongly enhances the oxidation process of methanol as the current density increases from 52.5 to 198.5 mA/cm2 when the urea content in the original electrospun solution was 4 wt% urea. Moreover, the nanofibrous morphology exhibits distinct impact on the electrocatalytic activity. Also, nitrogen-doping enhanced the stability of the introduced Ni-based electrocatalyst. Overall, the present study introduces effective and simple strategy to modify the electrocatalytic activity of the nickel-based materials.

Keywords : electrospinning, methanol electrooxidation, fuel cells, nitrogen-doping, nickel
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