A green approach for enhancing the electrocatalytic activity and stability of $NiFe_2O_4$/CB nanospheres towards hydrogen production

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ABSTRACT

Among the exfoliation processes applied on layered materials, it is the first time to explore the ultrasonic exfoliation in water for improving the catalytic properties of $NiFe_2O_4$/CB (CB = carbon black) nanospheres towards the electrocatalytic hydrogen evolution reaction (HER) in acidic media. It is found that after exfoliation, the overpotential of HER on $NiFe_2O_4$/CB nanospheres is improved by about 90 mV at a current density of 10 mA cm^{-2}. Moreover, the exfoliated $NiFe_2O_4$/CB nanospheres are not only more stable than the commercial Pt/C catalyst, but also they exhibit an overpotential improvement of about 100 mV at 50 mA cm^{-2}, after 6000 CV cycles. It is also found that the ultrasonic process causes uniformed $NiFe_2O_4$/CB particles, an increase of the electrochemical active sites, enriched Fe^{2+} ion and Fe^{3+} occupied on tetrahedral sites on the surface layer of the $NiFe_2O_4$/CB nanospheres, as resulted from the analysis with XPS, FTIR etc., leading to a higher activity and excellent durability. Furthermore, the approach also provides new insights on processing of materials in a green route.