Alkaline water electrolysis by NiZn-double hydroxide derived porous hexagonal nickel selenide-nitrogen doped graphene composite

Nadeema Ayasha and Sreekumar Kurungot

E-mail: a.nadeema@ncl.res.in

The global-scale application of water electrolysis, a technology for the storage of intermittent renewable energy in the form of hydrogen fuel, is possible only by the development of inexpensive, robust and bifunctional electrocatalysts. Herein, we report a simple and self-templating approach to design porous and edge sites rich hybrid nanomaterial *via* selectively etching of layered double hydroxide (LDH) precursors containing an amphoteric metal by alkali treatment followed by vapor phase selenization. The obtained porous nickel selenide anchored over nitrogen doped graphene (p-NSN) showed good bifunctionality towards alkaline water electrolysis with only 276 mV overpotential shift from 20% Pt/C at 10 mA cm^{-2} for water reduction and needed only 311 mV extra potential to achieve 10 mA cm^{-2} water oxidation current density in 1 M KOH. Despite high bifunctionality, faster reaction kinetics and long term stability encouraged us to demonstrate a real alkaline water electrolyzer which needed only 460 mV extra potential to generate sufficient amount of H_2 and O_2 product gases by achieving a current density of 10 mA cm^{-2}. Thus, it is belived that present study may provide a valuable strategy to tailor the catalyst surface texture as well as its effectiveness in developing a robust multifunctional electrocatalyst, and expand the way of designing porous materials for catalytic applications.