3D Porous Ni/NiO_x as a bifunctional oxygen electrocatalyst derived from Freeze-dried Ni(OH)₂

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The concomitant energy crisis has influenced the global research realm to develop some clean and alternative energy devices including Metal-air battery. However, the Metal-air batteries require further development for improving their efficiency and reducing the fabrication cost by using non-precious electrocatalyst.¹⁾ The non-precious transition metals including Mn, Co, Ni have well-reported oxygen bifunctional electrocatalyst.²⁾ For single metal oxides, oxygen electrocatalyst activities following the order of NiO_x >CoO_x > MnO_x., suggest that NiO_x is an excellent electro catalyst alternative to the precious metals.³⁾

Herein, Bifunctional electrocatalytic property of freeze-dried Ni/NiO_x, freeze-dried NiO, freeze-dried Ni(OH)₂ is reported. freeze-dried Ni/NiO_x, freeze-dried Ni was obtained from thermal annealing of the material. Both the Ni(OH)₂ and Ni/NiO_x could sustain with freestanding freeze-dried 3D structures without any carbon support. Freeze-dried Ni/NiO_x exhibited excellent bifunctional electrocatalytic property with the ORR performance at 0.62 V (half-wave potential) and OER at 1.47 V (η = 10 mA cm⁻²). Using freeze-dried metal hydroxide can be considered a wide range of carbon-free applications and improved electrocatalyst performance. The bifunctional catalytic activities were calculated to be 0.86, 0.98 and 1.14 V, respectively for freeze-dried Ni/NiO_x, freeze-dried NiO and freeze-dried Ni(OH)₂. The stacking of 2D sheets into 3D mass seems to play a vital role behind this excellent bifunctionality of freeze-dried Ni/NiO_x. The strategy that is developed, herein can be justified to obtain other transition metal-oriented bifunctional electrocatalysts.



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