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Hydrothermal Synthesis of β -Ni(OH)2 And Its Supercapacitor Properties

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Abstract: In present manuscript, we synthesized the Nickel hydroxide as an electrode material or supercapacitor application, using hydrothermal method with nickel nitrate as nickel source and hexamethylenetetramine as a directing agent. The reaction was carried out at 160^{0}C temperature for 18 hrs. The structural, morphological and electrochemical characterizations were studied by X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Cyclic Voltammetry (CV) and Galvanostatic Charge Discharge (GCD) respectively. Phase purity and crystalline nature of as prepared nickel hydroxide β-Ni(OH)$_2$ was reveled from X- ray study. Using Debye Scherer's formula crystallite size of ~15 nm was estimated for Nickel hydroxide. SEM reveals β-platelets like morphology of Ni(OH)$_2$ average of platelets length of the order of 1μm. Electrochemical studies (CV and GCD) were carried out in 2M KOH electrolyte solution. The maximum capacitance of 225 Fg^{-1} was observed for scan rate 5 mV within the potential window of 0.1 to 0.4 V.

Keywords:-Supercapacitor, Hydrothermal method, Nickel Foam, X-Ray Diffraction, Electrochemical Studies, Scanning Electron Microscopy,

INTRODUCTION

The device which stores charge within a two metal plate separated by dielectric is known as capacitor. Worldwide researchers are now trying to focus on enlarging the storage capacity of capacitor. The new evolution in energy storage gadgets are supercapacitor. They have capacity to store charge 100-1000 time greater energy than normal capacitor and have a much faster charge discharge rate as compare to battery. There are two types of Supercapacitor, electrical double layer capacitor which store energy with electrostatic charge and another is pseudocapacitor which stores energy through fast and reversible faradic surface. It is an electrochemical capacitor which have much high density in comparison with normal capacitor.They have major applications in automobiles as additional storage. Nowadays supercapacitor got much attention due to their high power and high energy storage capacity with long cyclic period. supercapacitor do not have dielectric medium like common capacitor and without using dielectric, supercapacitor plates are stuff with a greater surface area which can give high capacitance. In transition metal hydroxides one of the most important role is played by Nickel Hydroxide (Ni(OH)$_2$), because of its various properties and applications which is getting attention by the researchers for the supercapacitor. Nickel hydroxide crystallizes in two types of structures, Alpha and Beta nickel hydroxide. Alpha phase exhibits higher theoretical electrochemical capacity with metastable turbo static phase rapidly converting to beta phase during synthesis or in strong alkali media. So the beta phase is better option for supercapacitor material [1]. Due to its electro active nature and redox behavior, it is applicable in rechargeable batteries to store electrochemical energy. In the present manuscript we have synthesized nickel hydroxide via hydrothermal route and discussed its electrochemical properties for plausible use in electrochemical supercapacitor.

EXPERIMENTAL METHOD AND CHARACTERIZATION TECHNIQUES:

For the synthesis of nickel hydroxide nanostructures, Nickel nitrate [Ni(NO$_3$)$_2$.6H$_2$O] (98% purity) is used as precursor salt of nickel [New Modern Chemical Corporation, Mumbai (MCC)], Distilled water and Hexamethylenetetramine (HMTA) [National Chemical Laboratory, Pune] is used as solvent and directing agent respectively and Methanol E.P. (CH$_3$OH) (99%) [Analab Fine Chemicals, Mumbai] is used for cleaning purpose.

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