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摘要

Nickel hydroxide (Ni(OH)2) powder is synthesized by co-precipitation method and is deposited onto the stainless steel (SS) substrate by electrophoretic deposition (EPD) and dip coating, respectively. Electrochemical performances and capacitive properties of the deposited $Ni(OH)_2$ electrode after annealing at different temperatures for different lengths of time is investigated by cyclic voltammetry (CV). In addition, nickel oxide/carbon fiber (NiO/VGCF) and nickel oxide/carbon nanotube (NiO/CNT) composite electrodes are fabricated by EPD in order to enhance the capacitive behavior of the pure NiO electrode.

Surface morphology of the synthesized $Ni(OH)_2$ powder is platelet-like shape structure observed by SEM. Annealing temperature influences both the crystal structure and the specific surface area of the synthesized $Ni(OH)_2$. XRD results show that the $Ni(OH)_2$ converts into NiO after annealing at temperature higher than 300 ℃ due to the removal of water from $Ni(OH)_2$. BET analysis indicates that $Ni(OH)_2$ powder after annealing at 300 ℃ has the highest specific-surface area compared with other annealing temperatures.

An electrode after annealing at 300 ℃ has better capacitive behavior due to the conversion of $Ni(OH)_2$ to NiO. The oxidation and reduction peaks during CV scan appear at 0.45 V and 0.35 V versus Ag/AgCl reference electrode, respectively. Specific capacitance of an electrode after annealing at 300 ℃ is found to be about 140 Fg^{-1} at a scan rate of 10 mVs^{-1}.

The XRD and SEM results indicate that NiO particles are coated on the surface of carbon nanofiber/nanotube by EPD. The high conductivity of VGCF facilitates the redox reactions of NiO in 0.45 V (oxidation) and in 0.35 V (reduction), and therefore, promotes effectively the nickel oxide in the capacitance characteristics.

Compared with NiO electrode, the specific capacitances of NiO/VGCF and NiO/CNT composite electrodes are increased by 30 Fg^{-1} and 10 Fg^{-1}, respectively in scan rate of 10 mVs^{-1}. The results show that VGCF and CNT can improve the capacitive behavior of the composite electrode effectively.