Metal-organic framework/CNT based self-standing electrodes for asymmetric supercapacitor

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Statement of the Problem: Metal-organic frameworks (MOFs) have been used as electrode materials in energy storage devices due to the high specific surface area and various functionality [1]. Even though MOFs can offer high surface area, they usually exhibit low conductivity. The composite structures of MOFs with graphene and CNTs have been developed to improve the electrochemical storage capacity in batteries and supercapacitors [2,3]. In this work, the sandwich-like Mn-MOF/CNT and Co-MOF/CNT composite electrodes have been developed for asymmetric supercapacitor. Polyaniline coated CNT (PANI@CNT) and carboxylated CNT (c-CNT) were used for the fabrication of free-standing sandwich-like MOF/CNT composite paper. To achieve optimum porosity, the carbonization of the MOF/CNT composite materials was performed. The effect of carbonization process on energy storage performances of two different MOF/CNT based electrode materials were evaluated.

Methodology & Theoretical Orientation: The solvothermal synthesis of Mn-MOF was done by dissolving $MnCl_2.4H_2O$ (6 mmol) and 2-hydroxyterephthalic acid (1.2 mmol) in DMF and then it was activated by removing the solvent under vacuum at 100°C for 12 h. The same procedure was used for the synthesis of Co-MOF material by using $CoCl_2.6H_2O$ (6 mmol). The sandwich like MOF/CNT based electrodes were fabricated by the formation of continuous layers of both modified CNT (PANI@CNT, c-CNT) and MOF suspensions with vacuum assisted filtration. The characterization of electrode material was performed by XRD, SEM, TEM, Raman and XPS techniques. The supercapacitor performance of the free-standing sandwich-like MOF/CNT composite based electrodes was compared by cyclic voltammetry (CV) and galvanostatic charge-discharge (GCD) techniques. The effect of carbonization of active materials on the improved electrochemical storage capacity was also evaluated.

Findings: The purity and well-defined structures of Mn-MOF and Co-MOF were confirmed by XRD analysis and the obtained peaks agree well with the data in the literature.

References

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Biography

Dr. Elif Vargun's major is polymer chemistry and fabrication of nanomaterials in energy storage technology. She has the experience in controlled living polymerization techniques and has interest in the synthesis of sulfur/carbon composite based cathode materials and flame retardant polymer electrolytes for high energy density Li-S batteries. She is an assistant professor at Department of Chemistry, Faculty of Sciences, Mugla Sitki Kocman University in Turkey (13 articles, 95 citations, h-index 6). Since Sep 2018, she has gotten the postdoctoral researcher position at Centre of Polymer Systems of Tomas Bata University in Czech Republic. She is working on asymmetric supercapacitors at Sino-EU Joint Laboratory of New Energy Materials and Devices.

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