T431: **Nanotechnology for energy conversion and storage**

Basis controlled growth and electrochemical behavior of cobalt and 1,3,5 benzene-tricarboxylic acid-based MOFs for supercapacitor applications

Alberto Navarrete Villegas
Departamento de ingeniería metalúrgica. Universidad de Santiago de Chile

Major challenges in designing porous materials for supercapacitor application consist of developing facile synthesis methods for effective control of porosity, size of pores, and availability of free surfaces to enhance derived effects of electric double-layer conformation [1]. Metal-Organic Frameworks MOFs are coordinated polymers consisting of center metal ions (or clusters) and organic ligands as linkers, which coordinate to form one-, two- and three-dimensional frameworks. In recent decades, MOFs have emerged as a hope of appropriate electrode materials comprising requisites of suitable electrodes for supercapacitors. The leading features that make it suitable for electrode material are: High specific surface area (SSA), tunable size porosities, settable electrochemical properties, and the possibility of tailoring different dimensional structural design [2]. Here we report a simple and cost-effective approach to control the structure and microstructure of cobalt and 1,3,5 tricarboxylic acid-based MOF crystals, by in-situ addition of different molar concentrations of NaOH during solvothermal synthesis. Differences in morphologies of grown single crystals, preferred orientations of anisotropic growth, and coordination modes were observed, analyzed, and confirmed by X-Ray diffraction analysis and scanning electron microscopy. The synthesized MOFs were utilized as an active electrode material and electrochemical performances were measured in three electrode configurations. The electrochemical test suggested that control of the structure and direction of anisotropic growth in MOFs crystals would be able to produce structural features that improve both pseudocapacitive and double layer effects in MOFs varieties, in which tricarboxylic acid planes were grown in different orientations to long faces of acicular single crystals, creating surface exposed pores and interplanar cavities. Various synthesized MOFs by varying in situ concentrations of NaOH are examined as electrode material for supercapacitor performances. Moreover, electrolyte concentration is also varied (KOH: 1M, 2M, 3M) to evaluate the performances of the electrode materials. The maximal achieved specific capacitance of 261.27[F/g] is for MOF synthesized at 6mM of NaOH in 2M KOH electrolyte at current density of 0.5[A/g]. Retention of specific capacitance reached 84% after 2000 cycles of charge-discharge. The main achievement of this work is to obtain competitive values of specific capacitance, energy, and power densities from simple, inexpensive, and highly reproducible MOF crystals synthesized by hydrothermal method and to have an intercorrelation between structural and microstructural dependent electrochemical performance.

Acknowledgments

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References

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