NOVEL SOL-GEL SYNTHESIS ROUTE OF CARBIDE-DERIVED CARBON FOR VERY HIGH POWER DENSITY SUPERCAPACITORS

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Sol-gel synthesis process was applied to obtain titanium carbide. This material was used as precursor for the synthesis of carbide-derived carbon material for supercapacitor electrodes. The results of X-ray diffraction, scanning electron microscopy and Raman spectroscopy showed that the synthesized CDC material has average dimensions from 10 to 50 μm and is dominantly amorphous with some relatively small graphitic crystallites inside particles. The low-temperature sorption experiments were performed and the specific DFT surface area up to 276 $m^2\ g^{-1}$ for the synthesized carbide and up to 1710 $m^2\ g^{-1}$ for carbon were obtained. Compared to traditional titanium carbide-derived carbons the material exhibits larger specific DFT surface areas and a unique pore size distribution with more mesopores between 2 and 10 nm [1].

The energy-related properties of the supercapacitors based on the synthesized carbon material in 1M $(C_2H_5)_3CH_3NBF_4$ solution in acetonitrile were investigated using the cyclic voltammetry, electrochemical impedance spectroscopy and galvanostatic charge/discharge methods. This material demonstrates nearly ideal capacitive behavior even at very high charging/discharging currents (10 A g^{-1}) and potential scan rates (500 mV s^{-1}). The Ragone plot have been calculated from constant power tests, demonstrating high gravimetric energy density (20 Wh kg^{-1}) at high power density (200 kW kg^{-1}) [1].

References

[1] M. Pohl, H. Kurig, I. Tallo, A. Jänes, E. Lust, Novel sol-gel synthesis route of carbide-derived carbon composites for very high power density supercapacitors, Chemical Engineering Journal 320 (2017) 576–587.

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