Electrolytic Generation of Nano-Scale Carbon Phases with Framework Structures in Molten Salts on Metal Cathodes

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An electrochemical study of mechanisms of electrodeposition of carbon solid phases from halide melts (Na,K|Cl; Na,K,Cs|Cl), saturated with carbon dioxide under an excessive pressure of up to 1.5 MPa, has been carried out in the temperature range 550 – 850 °C by cyclic voltammetry. It has been found that the cathode process occurs in three steps at sweep rates of less than 0.1 $V\,s^{-1}$, and its electrochemical-chemical-electrochemical (ECE) mechanism is suggested. It has furthermore been found that cathodic deposits contain nano-sized carbon particles of different forms and structure: blocks of amorphous carbon, crystalline graphite, carbon nanotubes (CNT), and nanofibres. The outer diameter of the tubes is 5 – 250 nm, and the internal diameter is 2 – 140 nm. A correlation between the product structure and yield against electrolysis conditions and regimes has been established.

Key words: Chloride-Oxide Melts; Carbon Dioxide; Excessive Pressure; Carbon Nanotubes; Product Characterization.