ELECTROCHEMICAL PROCESSES AT DIAMOND COMPOSITE ELECTRODES

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A considerable variety of carbon materials is known and has been characterized and employed tailored to needs in specific electrochemical processes. In particular, the recent accessibility of different forms of diamond as a uniquely inert and versatile electrode material had a considerable impact in applications such as water treatment and electroanalysis. The electrochemical properties of diamond depend on the type and extend of doping and therefore on the method of synthesis. Work described in this paper is aimed at exploring the application of ultra-disperse diamond nano-powders formed via explosion synthesis methods for applications in electrochemistry.

Two types of ultra-disperse diamond, “grey” and “black”, produced commercially via explosion synthesis techniques, are investigated for their electrochemical characteristics. Both types of diamond consist of nanoparticles 5 to 15 nm in size.

Co-deposition with metal oxides and screen-printing technology are examined. Both allow the diamond nano-powders to be employed for electrodes with well-defined and reproducible properties. It is shown that the electrical conductivity of “grey” (sp^2 carbon poor) diamond nanoparticles is insufficient for electrochemical applications. However, “black” (sp^2 carbon rich) diamond nanoparticles (with graphitic surface domains) act as highly active electrode materials, when compared to conventional graphite and glassy carbon electrodes. Most striking is the ability of “black” nanoparticulate diamond to promote surface sensitive processes, such as hydroquinone/quinone redox chemistry, hydrogen evolution, and oxygen evolution processes.

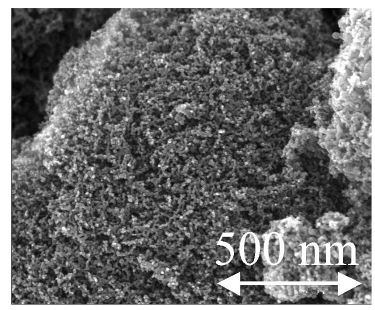

Fig. 1. SEM image of ‘black’ diamond nanoparticles, which are approximately 5 – 15 nm in diameter.