

Synthesis, structure, and properties of C₆₀-Pd spherical nanoparticles

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The C₆₀-Pd polymer can be synthesized electrochemically¹ or chemically.² The electrochemical synthesis results in the formation of thin and uniform film on the electrode surface. The film is electrochemically active at negative potentials due to the fullerene cages reduction.¹

The chemical synthesis of C₆₀-Pd polymer, carried out in benzene solution containing Pd₂(dba)₃·CHCl₃ and fullerene C₆₀, results in formation of large crystalline superficial structures which are composed of a small spherical particles 20-200 nm in diameter (Fig. 1). These cubic semi-crystals can be disintegrated to spherical nanoparticles with the high energy ultrasound. The size of synthesized C₆₀-Pd nanoparticles can be controlled by composition of grown solution, time of polymerization, temperature of synthesis, and stirring conditions. The most uniform in size particles were synthesized in solution containing 3:1 ratio of [Pd] to [C₆₀] concentration. Dispersed C₆₀-Pd nanoparticles are stable in many organic protic and aprotic solvents. The electrochemical properties of films formed from chemically synthesized nanoparticles were investigated. Special attention was paid to capacitance properties. The electrochemical behavior of these films resembles the one observed for electrochemically synthesized polymers. Capacitance properties of films formed from C₆₀-Pd nanoparticles depend on the size of polymeric nanoparticles. The specific capacitance of polymer formed in solution containing 1:1 ratio of [Pd] to [C₆₀] reaches the value obtained earlier for electrochemically synthesized material.

The electrochemical properties of colloidal solutions of C₆₀-Pd nanoparticles were also studied using ultramicroelectrodes. Diffusion controlled voltammograms are recorded for these systems.

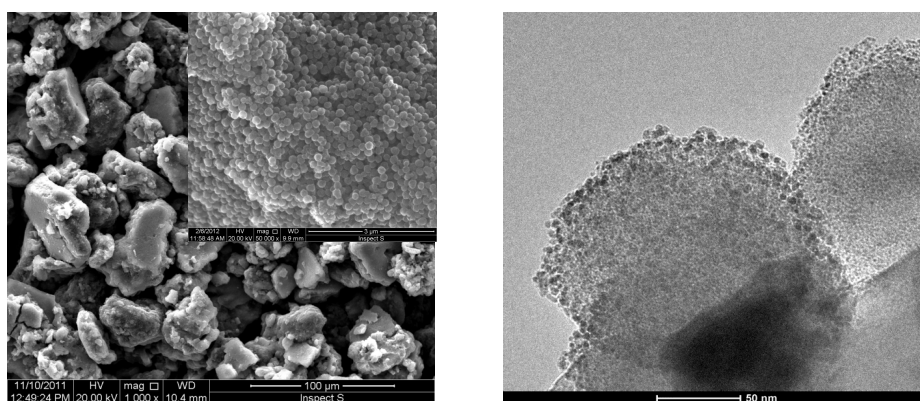


Fig. 1. SEM (left panels) and TEM (right panels) images of chemically synthesized C₆₀-Pd in benzene solution containing 0.48 mM C₆₀ and 0.73 mM Pd₂(dba)₃·CHCl₃

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2. H. Nagashima, A. Nakaoka, Y. Saito, M. Kato, T. Kawanishi, K. Lotha, *J. Chem. Soc. Chem. Commun.*, 377-379 (1992)