

ATOMIC FORCE MICROSCOPY AND ELECTROCHEMICAL STUDIES OF PALLADIUM NANOPARTICLES AND NANOWIRES ELECTRODEPOSITED ONTO CARBON ELECTRODE SURFACES

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In situ and *ex situ* atomic force microscopy (AFM) and voltammetry were used to study nanoparticles and nanowires of palladium electrodeposited on the surface of two carbon electrodes: highly oriented pyrolytic graphite (HOPG) and glassy carbon [1]. The morphology, size, shape and distribution of the palladium nanostructures are influenced by the electrodeposition parameters, the concentration of the precursor solution and the topography of the carbon substrate, with potential applications in nanotechnology.

Reducing the rate of growth of the Pd(0), using underpotential deposition and decreasing the concentration of the palladium plating solution, the dimensions and the shape of the Pd(0) nanowires can be controlled. As a result, the underpotential deposition process is a simple procedure for the production of thick uniform palladium nanowires under ambient conditions of pressure and temperature, Fig. 1A. On the contrary, the formation of small Pd(0) nanoparticles with a uniform distribution over the electrode requires fast electrodeposition that can be achieved by overpotential deposition and high Pd²⁺ concentration in solution, Fig. 1B.

The growth of the Pd oxide layer begins at negative potentials with the formation of a palladium oxide pre-monolayer film. This phenomenon is strongly dependent on the size and morphological characteristics of the Pd(0) nanostructures existent on the surface of the electrode, relevant for palladium electrocatalysis. At high positive potentials, the Pd(0) nanoparticles and nanowires undergo oxidation leading to the formation of a mixed oxide layer, which in turn may act as nucleation points for additional Pd metal growth, increasing the metal electrode surface coverage.

References:

- [1] V. C. Diculescu, A.-M. Chiorcea-Paquim, O. Corduneanu, A. M. Oliveira Brett, J. Solid State Electrochem., **11** (2007) 887.

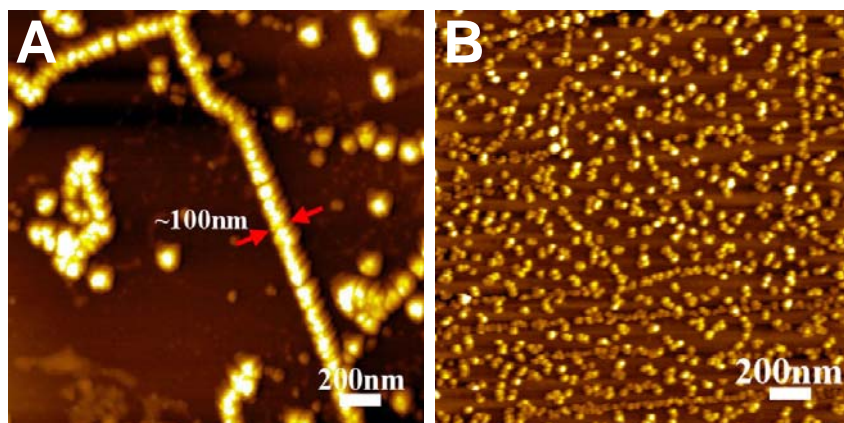
Figures:

Fig. 1 AFM topographical images of Pd(0) deposited on the HOPG during 30 min, from solutions of (A) 0.1 mM PdSO₄, at -0.45 V and (B) 1.0 mM PdSO₄, at -1.00 V.