Nanostructured Films of Conducting Polymer Linked and Polyoxometallate Stabilized Platinum Nanoparticles

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There has been a growing interest in the fabrication of organized monomolecular (monolayer) and multilayered assemblies at solid surfaces. Most of research concerns alkanothiols and their derivatives that can be successfully employed to obtain monolayer coverages on gold. An interesting alternative originates from the possibility of self-assembling inorganic (e.g. polyoxometallate) monolayers because they provide potentially better stability, and they undergo reversible stepwise electron transfer reactions of importance to such technologies as electrocatalysis, electrochromism, molecular electronics and sensing. We pursue here the concept based on multiple formation of two-dimensional arrays composed alternately of a conducting polymer, such as polyaniline or polypyrrole, and a heteropolyanion of molybdenum or tungsten. By repeated and alternated treatments in the appropriate solution, the amount of material on the electrode surface can be increased systematically in a controlled fashion leading to stable three-dimensional multilayered assemblies [1].

Monolayers of alkanothiolates are capable of passivating gold nanoparticles and producing alkanothiolate monolayer protected clusters of gold [2]. They combine bulk and molecular properties within a nanometer scale material that is expected to yield novel and promising size-dependent electronic, optical and chemical properties. In the present work, we explore the ability of polyoxometallates (phosphotungstate, phosphomolybdate) to form self-assembled monolayers on metal (platinum) nanoparticles (ca. 7-10 nm). Such polyoxometallate covered (protected) particles can be linked together by ultra thin conducting polymer (polyaniline, polypyrrole) bridges. The formation, morphology, structural transformations and electrochemical properties of the nanoparticle containing three-dimensional network films are examined using cyclic voltammetry, potential step techniques, microgravimmetry, FTIR spectroscopy, STM and scanning electrochemical microscopy. The films produce molecular systems capable of charge storage in bilayer type coatings as well as organized monolayer and multilayer assemblies with specific electrocatalytic properties.

References

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