Biomimetic Synthesis of Silver Nanoparticles [*]

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Biomimetic synthesis has become a promising field in inorganic materials chemistry research in recent years. Nanoparticle nucleation and growth induced by Langmuir monolayers of biological surfactant embodies the mechanism of biomimetic synthesis. It is generally believed that Vitamin E (VE) is indispensable component of biological membranes, and can protect the membranes from damages induced by lipid peroxidation through their chemical antioxidation. It is significant to study inorganic nanoparticle nucleation and growth induced by VE langmuir monolayers.

The one-step synthesis of silver nanoparticles underneath VE Langmuir monolayer, and their assembly into ordered array were described in this paper.The reduction of the silver ions occurred by electron transfer from ionized phenol groups of VE, and the interaction of them stabilized the particles against aggregation. The results showed that the area per molecular of VE on the 10^{-1} mmol/L Ag_2SO_4 subphase at pH 10 was lower than that of VE on pure water, but increased with time of reaction because of some interactions between of the Ag^+ ions with the phenolic headgroups of VE. The particle size of Ag nanoparticles formed at the air-water interface was ca.10nm, and the array of the nanoparticles did change with time of reaction from sparse to close-packed. The electron diffraction pattern of the silver particulate was analyzed for a face-centered cubic polycrystalline structure. The UV-vis spectra of silver nanoparticle films of different thickness deposited on quartz by the LB technique showed the surface plasmon band increases linearly with increasing film thickness, indicating close to unity monolayer transfer ratios. The multilayer Langmuir–Blodgett films were characterized by Fourier transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS). FTIR revealed clearly that the phenolic groups in the VE molecules were converted to a quinone structure, and XPS suggested silver ions were reduced to metallic silver.

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