Preparation of Metal Nanoparticles by Jet Electrodeposition Using Monocrystalline Silicon Substrate

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This study proposes a method for rapid preparation of nanoparticles (NPs) by jet electrodeposition on silicon substrate. Micropyramidal structures were formed on a specific crystallographic plane of monocrystalline silicon substrate after polishing and alkali treatment. With cathode translational motion and high current density, jet electrodeposition discharged metal ions into atoms that rapidly assembled at the tip of silicon micropyramids to form nuclei and generate NPs. The effects of surface roughness, current density, and cathode translational speed on NP size and distribution uniformity were investigated by using copper NPs as the research object. NP size distribution rules for different parameters were obtained by the field emission scanning electron microscopic image analysis and optimized process parameters. Results showed that low silicon substrate roughness was favored preparation of copper NPs with good size refinement and uniform size distribution. Moreover, these NPs exhibited desirable refinement and uniformity when the current density was 200 A/dm² and cathode translational speed 480 mm/min.

Keywords: jet electrodeposition; nanoparticles; surface roughness; current density; cathode translational speed

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