Deposition Behavior of Ni-SiC Nano-Composites Under Triangular Waveform

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Abstract

Electrodeposition is a very effective method of fabricating nanosized materials. The selection of proper electrodeposition parameters, e.g., bath composition, pH value, additives, current conditions, etc., will result in massive nucleation and reduction of grain growth. In this paper, a triangular waveform with relaxation time was chosen to synthesize Ni-SiC composites. β SiC powders of diameter of about 100nm were used, which was shown to be able to increase nucleation sites and perturb the growth of the nickel matrix. The grain size of the composites was observed using the transmission electron microscopy (TEM). The application of triangular waveform with relaxation time and the particles was found to be an effective and viable processing technique for producing nanosized coatings.

An equivalent circuit (EC) model based on the results of electrochemical impedance spectroscopy was formulated to simulate the charge transfer process under triangular waveform and direct current conditions. The EC model can successfully explain the deposition behavior of the electrocomposition. It is shown that at the same average current density, the triangular waveform current can provide a much higher instantaneous peak current for charge transfer. A high current is detrimental to the crystal growth, resulting in an improvement in morphology and hardness of the composites. The mathematical model has found to be in agreement with the experimental results.

Presentation: **Oral**

Session: **A2---nanotechnology**

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