Analysis of Fe–Ni Thin Films Using the Phenomenological Theory of Electrodeposition

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Fe–Ni thin films electrodeposited using rectangular pulse voltages over a megahertz frequency range were investigated through scanning electron microscopy-energy dispersive X-ray spectroscopy and X-ray diffraction. The Ni content of the Fe–Ni thin films increased with the cathode potential; further, it significantly changed at resonant frequencies when the cathode potential was equal to the Fe^{2+} or Ni^{2+} potential barrier, and became constant, which was consistent with the phenomenological theory of electrodeposition. The Fe^{2+} and Ni^{2+} potential barriers were determined to be 1.48 and 2.22 V, respectively. The Fe–Ni thin films comprised a body-centred cubic crystal structure, namely, α -Fe, and an amorphous structure $\text{FeNi}_{0.832}$ phase (corresponding to the stoichiometric molar ratio of Fe–Ni thin films containing 29.8 at% Ni). The Fe–Ni films had smooth surfaces, which indicated that they were formed by layer-by-layer growth and not by island growth.

Keywords: Fe–Ni thin film; Phenomenological theory of electrodeposition; α -Fe; $\text{FeNi}_{0.832}$; Smooth surface

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