Prediction of the Elemental Content of Thin Films Electrodeposited from a Multi-component Solution: Co–Ni–Fe– Mn Thin Film as an Example of Multi-element Electrodeposits

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The elemental content of Co–Ni–Fe–Mn thin films electrodeposited by a rectangular pulse voltage were investigated using energy dispersive X-ray microscopy (EDX). The EDX analyses revealed that the behaviors of the mean elemental content M_i , where i denotes an element of the Co–Ni–Fe–Mn thin films, were divided into three groups by the potential barrier V_{bi} and cathode potential V_c : (a) for $V_c > V_{bi}$, the values of M_i were consistent with the activity S_i of element- i in the solution, (b) for $V_c = V_{bi}$, the oscillation of the element- i content occurred at specific frequencies of the rectangular pulse voltage, and (c) for $V_c < V_{bi}$, M_i were determined by $S_i J_i$ where J_i denotes the current in the Fowler–Nordheim equation that represents the emission of electrons from the Fermi level to the energy level of i -ions on the electric double layer. This study demonstrated that the elemental contents of multi-element electrodeposits can be predicted using V_{bi} and V_c .

Keywords: Multi-component electrodeposit; Potential barrier; Cathode potential; Fowler–Nordheim equation;

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