Nickel Thin Film Resonantly Generated at a Rate of Megahertz

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Resonant frequencies at which masses of Ni thin films deposited from a nickel sulfamate solution significantly increase are observed using a rectangular pulse current technique having a frequency of the megahertz scale. The resonant frequency spacing between the neighboring resonant frequencies keeps a constant value of 0.2 MHz. The presence of many resonant frequencies and the constant resonant frequency spacing show an energy level transition between an electron at the Fermi energy level in an electrode and a nickel sulfamate ion characterized by a quantized rotational energy level. In addition, at a frequency beyond the highest resonant frequency the normalized deposition mass that keeps a constant value nearly equal to 1 is found. The frequency named as a non-capacitative frequency shifts to a lower frequency with an increase in the solution temperature. This indicates that the electric double layer in the solution loses a capacitative property owing to nickel sulfamate ions that do not rotate at the applied pulse frequency.

Keywords: resonant frequency; electrodeposition; energy level transition; Ni thin film; quantized rotational energy level

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