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Electrodeposited NiFeCo Alloys for Magnetoelastic Resonators

J. Pillars[1], T. Monson[1], M.L. Gucik[1], E. Langlois[1]

[1]*Sandia National Laboratories*, DOE Laboratory, US, jrpilla@sandia.gov

Magnetoelastic materials such as CoFe and NiFeCo alloys display Joule magnetostriction. This property of ferromagnetic materials is usually minimized as a loss mechanism in applications such as inductor or transformer cores. Though, for use as a resonating material in a sensor application, this material provides a battery-less system where an external device can apply a magnetic field and receive a magnetic "signal" in return based upon the resonant frequency, geometry, and mass. As-deposited CoFe and NiFeCo films have no measurable resonant frequency when analyzed with a vector network analyzer and biasing Helmholtz coils. To control magnetic properties of the electrodeposited alloys, the stoichiometry was controlled and additional elements such as boron, niobium, silicon, germanium, and holmium were added to the chemistry. The electrical resistivity was increased and the magnetic properties such as permeability, coercivity, and magnetic saturation were controlled and comparable to commercial, extruded ribbon materials such as Metglas. Annealing studies in a magnetic field, applied both parallel and perpendicular to the easy axis of the NiFeCoBNbSi and other alloy films, were used to adjust the anisotropy and the permeability of the material.

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