Microstructure, mechanical behavior and electrochemical response of gradient metallic materials produced by electrodeposition

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The strength-ductility tradeoff, microstructural instability and unusual electrochemical response are the challenging issues of fine-grained metallic materials. The concept of inducing chemical and microstructural heterogeneity including gradient is seemed to be one of the promising strategies for achieving synergy among various properties [1,2]. The present study is aimed at producing gradient metallic materials by electrodeposition and subsequently evaluate their mechanical and electrochemical behaviors. The studies are performed on iron and nickel & alloys, as model materials, to demonstrate the effects of gradient in microstructure and composition on microstructural stability, corrosion, wear resistance and tensile properties. Continuous linear and alternate multilayer gradients in both microstructure and composition are established by tailoring the electrodeposition parameters and bath chemistry. The gradient metals with linear microstructure variation have exhibited differential rates of oxidation kinetics as a function of grain size and better corrosion performance. The compositional gradient alloys have exhibited superior contact damage resistance at reduced solute contents due to lowered residual stresses. The presence of interfaces in multilayer gradient materials have shown detrimental effects on tensile ductility.

Keywords: Electrodeposition; Gradient materials; Microstructure; Mechanical properties; Oxidation.

References:

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