The Mechanical Behavior and Microstructure of a Multilayer Nanostructured Ni-Co Alloy Fabricated by Electrodeposition

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A bulk multilayer nanostructured Ni-Co alloy with nano-grains (NG) layer with a thickness of 2.7 μ m and ultrafine grains (UFG) layer with a thickness of 0.9 μ m alternately grown is fabricated by an electrodeposition process. The analysis from X-ray diffractometer and transmission electron microscope reveal that the well-defined alternative layers consists of NG with a mean size of 23 nm with a random growth and UFG with a mean size of 90 nm along a (200) preferential growth. Tensile tests show that the multilayer nanostructured Ni-Co alloy exhibits an enhanced ductility with an elongation to failure of 14.2% and higher ultimate tensile strength of 1851MPa compared with the monolithic UFG and NG counterparts. The enhanced ductility for the multilayer nanostructured Ni-Co alloy is attributed to the improvement of work hardening ability brought by the action of the special microstructure involving the periodical distribution of UFG layer, the existence of interface and the alternation of crystal orientation between the layers in the dislocation activities and the effective adjustment to the local stress concentration brought by the periodic existence of the UFG layer in this layer structure. The higher strength sourced from the extra reinforcement provided by the hinder of interface to dislocation movement.

Keywords: Nanostructured Ni-Co alloy; Multilayer; Electrodeposition; Ductility; Strength

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