The electrolytic plating of compositionally modulated alloys and laminated metal nanostructures based on an automated computer-controlled dual-bath system - DTU Orbit (11/02/2019)

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Compositionally modulated alloys (CMAs) and laminated nano-structures of metals are attracting ever-increasing enthusiasm due to their unique mechanical, electrical and, in particular, magnetic properties when compared to those of the respective bulk metals, and as evidenced by new and fascinating applications reported in the literature. Until recently, however, producing such multilayered coatings has been difficult at best, especially for larger samples of irregular configuration and in mass production. We will explain the design, objective and the use of our newly developed automated computer-controlled plating system for producing large-scale CMA coatings and laminated nano-structures of metals. Electroplating bath constituent concentrations, pH, temperature, mode of agitation, etc, as well as galvanostatic modes, e.g. direct current (d.c.) versus pulsed and/or pulse reversal currents, were optimized. Employing the automated dual-bath technique, multilayered composite materials of copper-nickel and copper-cobalt with more than 1000 alternating layers of varying dimensions, if desired, have been investigated and manufactured. The thickness of each sub-layer ranges from 25 nm to several micrometres (μm). Effort was also expended in the generation of CMA structures from single electroplating baths where the two metals of interest were present.

The characterization results, as elucidated with scanning electron microscopy (SEM), atomic absorption spectroscopy and x-ray fluorescence and diffraction methods, and applications for such multilayered systems, in general, as well as the possibilities and limitation of the plating system are discussed.

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