Nanocomposites and nanomaterials

High-Themperature Electrochemical Synthesis of Nanopowders of Molybdenum (Tungsten)–Nickel (Cobalt) Alloys and Intermetallic Compounds

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For the cathodic codeposition of metals, the correspondence of their crystalline lattices and the difference in their standard electrode potentials are of great importance. It seems significant from a practical point of view to study the electrodeposition of alloys whose components have crystalline lattices of different types but similar electrode potentials.

The analysis of the experimental data suggests that reversible equilibria and processes involving nickel and cobalt(II) can occur in the sodium tungstate melt. The addition of molybdenum(VI) oxide to the nickel-containing tungstate melt induces the dimolybdate-ion reduction wave. The difference in the potentials of nickel and molybdenum deposition is 0.09–0.115 V at 1173 K. Electrolysis was carried out at cathodic current densities of 0.05 and 0.1 A/cm^2 in the same temperature range (1123–1173 K). The concentration of MoO_3 was maintained at 1.0–2.5 mol %, and the NiO concentration was varied from 0.1 to 1.0 mol %. Intermetallics MoNi, $MoNi_3$, and $MoNi_4$ are sequentially deposited on the cathode at 1123–1173 K from the melts containing 0.1–1.0 mol % NiO. The same results were otained for systems Na_2WO_4–MoO_3–CoO, Na_2WO_4–WO_3–NiO, and Na_2WO_4–WO_3–CoO.

It was shown that molybdenum (tungsten)–nickel (cobalt) alloys and intermetallics can be deposited as nanopowders from oxide melts. The composition and structure of the deposits can be controlled by varying the concentration of the corresponding components in the melt, the temperature, and the cathodic current density.