

Nanocomposites and nanomaterials

High-Temperature Electrochemical Synthesis of Nanopowders of Molybdenum, Tungsten, and Chromium Borides from Halide-Oxide Melts

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Small additions of boron oxide to the NaCl-Na₃AlF₆ melt (1:1) lead to the appearance of a reduction wave at the potentials from -1.1 to -2.2 V. The shape of the cyclic voltammogram indicates the irreversible nature of the charge transfer stage. It was found that the product of the potentiostatic electrolysis at the potentials from -1.7 to -1.9 V is highly dispersed amorphous boron.

The reduction wave of oxo-fluoride complexes of molybdenum and boron corresponds to the potentials within interval -1.0 ÷ -1.2V. This indicates that molybdenum is more electropositive than boron by 0.5-0.7 V. A similar picture is also observed in the reduction of oxofluoride complexes of molybdenum, tungsten, chromium, and boron. Therefore, in deciding on concentrations of an oxide or oxo salt of a highly melting metal, it is necessary to consider that, at the first stage of the electrochemical synthesis, molybdenum, tungsten, and chromium oxide are deposited with the formation of a metal-salt bulb. Boron starts to deposit if the oxide or oxo salt of a highly melting metal is spent.

The electrochemical syntheses of molybdenum and tungsten borides on Ni or W cathodes were performed from molten NaCl-Na₃AlF₆-Na₂MO₄(MO₃)-B₂O₃ mixtures (where M = Cr, Mo, W). In these systems, all individual components as boride of a metal with high boron content (MB₄) and mixtures including lower boron content borides are separately produced depending on the melt composition and electrolysis parameters (composition of the bath, cell voltage, temperature, and duration of electrolysis).