Nanocomposites and nanomaterials

Corrosion resistance of refractory metals borides and carbides nanopowders in nickelage electrolytes

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The purpose of the present work was to investigate the corrosion resistance of nanopowders of borides and carbides of zirconium, titanium, vanadium, chromium, molybdenum, and tungsten in the nickelage electrolytes depending on the acidity of the electrolyte, and also on temperature and duration of the interaction.

The test objects were nanopowders of borides and carbides of zirconium, titanium, vanadium, chromium, molybdenum, and tungsten, and also silicon carbide, obtained by plasmachemical and high-temperature electrochemical synthesis methods.

The acidity of the electrolyte was adjusted by addition of concentrated sulfuric acid. Concentration of powders of carbides and borides in all experiments was 10 kg/m^3.

Dissolution rate was calculated by the quantity of insoluble residue and by the concentration of carbide(boride)-forming element ions in the electrolyte determined by the magnetometric method.

It was noted that, for carbides and borides, materials corrosion resistance was comparable and attributable primarily to the electrolyte acidity. In acid electrolytes (pH = 2.0 ÷ 3.0), nanopowders are quickly dissolved. Thus, after 3 h at T = 323K, borides dissolution rate was 15,6-9,5%, after 24 h – 38,2-31,0%, and after 240 hours – 89,9-75,1%. Nanopowders of metal-like carbides have higher corrosion resistance: similar to borides dissolution rates are achieved respectively for 24, 120, and 360 h. For all the materials, decrease of corrosion resistance with increase of temperature and increase the specific surface area during dissolution were observed. The specific surface area value was 2000-10000 m^2/kg while retaining particles forms indicating predominantly layered nature of the process. The only exception is silicon carbide nanopowder which degree of dissolution in the whole pH and temperature range investigated did not exceed 7-10%.