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MECHANOCHEMICAL SYNTHESIS OF NB/MGO COMPOSITE FROM MAGNESIUM NIOBATE MGNB2O6 AND NIOBIUM OXIDE NB2O5

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The growing demand for the production of modern materials based on highly dispersed metal powders necessitates the development of innovative "breakthrough" technologies for their creation. The main industrial methods for the production of niobium and its alloys are metal-thermal reduction of oxide compounds: aluminothermic, sodium-thermal, carbothermal from a mixture of Nb_2O_5 and soot. The reduction reactions of metal oxides that proceed with a large exothermic effect can be carried out in the process of mechanical activation alone.

Mechanical activation of solid mixtures of metal oxides with active metal leads to an increase in the contact surface area, acceleration of mass transfer, and, as a result, activation of their mechanochemical interaction with the formation of composites (Me/(Meact)xOy) - powder mixtures of highly dispersed particles of reduced metal and active metal oxide [1, 2]. As an active metal, it is possible to use various active metals Al, Zn, etc. To extract a reduced element from mechanochemical composites without disturbing its finely dispersed state, it is necessary to choose an active metal oxide solvent that would be simultaneously inert with respect to the reduced metal. The most promising active metal is magnesium, which, during mechanical activation, forms the MgO phase, which prevents significant sintering of mechanical activation products; when interacting with dilute solutions of HCl or H_2SO_4, magnesium oxide forms well-soluble compounds [3].

The aim of this work is to study the conditions of mechanochemical synthesis of magnesium niobate ($MgNb_2O_6$) and its reduction and simple niobium oxide (Nb_2O_5) by magnesium with the formation of Nb/MgO mechanocomposites for subsequent separation of finely dispersed niobium powder from such composites by the method of acid dissolution of magnesium oxide.

We propose a mechanochemical method for the synthesis of magnesium niobate by activation of mixtures of MgO with Nb_2O_5. It has been shown by X-ray phase analysis (XPA) that 8 min of activation of the corresponding oxides is sufficient for the formation of $MgNb_2O_6$ (with a strict stoichiometry of 1:1 and a drum rotation speed of 1000 rpm in a high-energy planetary mill). The diffraction patterns of the samples synthesized under such conditions by mechanochemical activation are in good agreement with the literature data.

Mechanochemically synthesized magnesium niobate was used for mechanochemical reduction with magnesium. From the results of X-ray phase analysis of the products of mechanochemical reduction of $MgNb_2O_6$ with magnesium, the optimal conditions for mechanical activation and the ratio of components of mixtures of $MgNb_2O_6$ with Mg were determined. It has been shown that at a speed of rotation of the drums around a common axis of 1000 rpm, mechanochemical redox reactions completed with the formation of Nb/MgO composites within an activation time of 8 min.

A study of the mechanochemical reduction of niobium oxide (Nb_2O_5) with magnesium showed that the formation of the Nb/MgO composite occurs at a ratio of Nb_2O_5 : Mg mixture components of 1:5.2 at a rotation speed of the drums about a common axis of 1000 rpm. for an activation time of 4 min.

The method presented by us makes it possible to obtain highly dispersed niobium powders by mechanochemical synthesis practically at room temperature with a high (97%) yield and the possibility of utilizing magnesium oxide by-product by known methods.

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