

Synthesis of complex oxides transitive metal powders in aqueous media

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Abstract

On the basis of regularities of complexation and ion exchange in aqueous media, there have been developed a strategy and principles of directed synthesis of materials as monophase nano-size powders of alkali metal metaniobates (metatantalates), as well as metatitanates of di-valent metals (strontium, barium and lead). We have found ways for obtaining precursors that preclude the development of olation-oxolation processes and studied the effect of reagent concentration and temperature on the composition of solid phases formed. The basis for the approaches to the formation of solid phases of desired composition became a study into the processes of cation displacement using inorganic precursors. The values of constants of the process of the alkali metal cation displacement by hydrogen ions in hydrated niobates(tantalates) and titanates have been determined. The affinity of the alkali metal cation to the hydrated matrix of titanium(IV), niobium(V) and tantalum(V) depends on the degree of alkali metal cation hydration. We determined the conditions for the existence in aqueous media of solid phases with the ratios $M:Nb(Ta) = 1$ and $M:Ti = 2$ ($M - Li^+, Na^+, K^+$), corresponding to the composition of hydrated alkali metal metaniobates, metatantalates and metatitanates. Thermal treatment of these precursors results in monophase crystalline nano-size or superdispersed powders of alkali metal metaniobates, metatantalates and metatitanates of stoichiometric composition. By using hydrated titanates of singly charged cations with $M:Ti = 2$ ($M - NH_4^+, Li^+, Na^+, K^+$) as precursors in aqueous media was studied the process of the formation of monophase crystalline nano-size powders and superdispersed powders of stoichiometric barium, strontium and lead metatitanates. The effective way of synthesis providing obtaining of monophase nanosized powders of complex oxides of transitive metals of the stoichiometric composition and solid solutions on their basis is developed.