

MECHANICAL ACTIVATION AND THERMAL EXPLOSION IN TI-NI AND NB-SI SYSTEMS

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Mechanical activation (MA) is an effective method to increase the reactivity of condensed substances and expand significantly the possibilities of material synthesis [1, 2]. This method is widely used for the synthesis of low-energy compounds which practically do not burn under the typical conditions of synthesis.

During MA, the particles of reacting components are pumped with additional (excess) energy that reduces the activation barrier of chemical reactions. Another important factor that accelerates the formation of reaction products during MA is the grinding of substances and the formation of mechanocomposites (particles), the interphase surface of which is substantially increased [3, 4].

This work provides the experimental and theoretical studies of two-stage mechanochemical synthesis in metal-metal and metal-nonmetal systems. The Ti-Ni and Nb-Si systems are considered to be examples.

The studies conducted show that the preliminary mechanoactivated Ti + Ni mixture does not contain reaction products. However, the intensive formation of mechanically synthesized silicides was observed during the mechanical treatment of the Nb + 2Si mixture.

The dynamics of mechanochemical synthesis is studied. The results have shown that preliminary mechanoactivation intensifies chemical transformations, reduces the ignition temperature and the maximum synthesis temperature at the stage of thermal explosion and contributes to the transition of chemical interaction with the participation of liquid phase into the solid-phase regime (without melt formation) in the Nb-Si system.

Thermokinetic and thermophysical constants determining the mechanochemical synthesis of TiN and NbSi₂ products are calculated using the experimental data and the inverse method. The optimal regimes are found for the two-stage mechanochemical synthesis of these products, depending on the parameters determining the process.

References

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