MORPHOLOGY STUDY OF LAYERED AGGLOMERATES DURING MECHANICAL ACTIVATION OF A TITANIUM-NICKEL POWDER MIXTURE

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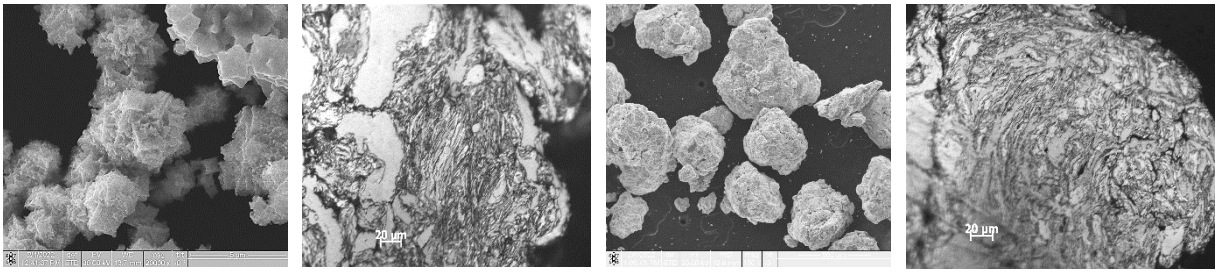
Mechanical activation (MA) is one of the methods of intensification of chemical processes involving solids. The structure of the powder mixture formed during the MA has a significant effect on the subsequent synthesis process and the resulting product. During the MA, many processes take place that are involved in the formation of the powder mixture.

During MA, not only a decrease in the particle size of the substance occurs, but also deep physico-chemical transformations: violations of the initial structure up to the achievement of an X-ray amorphous state; the formation of a qualitatively new particle surface, the occurrence of plastic deformations and point defects, the rupture of chemical bonds and the appearance of free radicals, which ultimately leads to an increase in the reactivity of solids [1 – 3].

In this work, titanium (PTS) and nickel (PNCL7) powders of Ti – Ni 55.06 wt.% were used. MA was carried out in a planetary mill (60g, air medium, MA time from 0.5 to 10 min., Mp:Mb = 5:1). After the MA, a thermal explosion was carried out and the temperature characteristics of combustion were recorded. Morphology and phase composition were studied using the Quanta 200 3D system, XRD-6000 diffractometer, and Axiovert 200 MAT/M microscope.

Fig.1 shows the external and internal structure of the powder mixture after 0.5 and 4 min MA. The powder mixture consists of agglomerated particles of various sizes. The size of agglomerates is constantly changing throughout the MA. During MA, two main and opposite processes occur: grinding and agglomeration. They influence the formation and size of agglomerates. The internal structure of the agglomerate consists of layers of titanium and nickel, the dimensions of which also change throughout the MA time.



a b c d

Figure 1. SEM photo of the powder mixture (a, c) and the cross section of the layered agglomerates (b, d) after 0.5 min (a, b) and 4 min (c, d) of mechanical activation

The external and internal structure of the formed layered agglomerates were studied. The average size of the agglomerates and inner layers were calculated after different MA times. These sizes change throughout the time of the MA. Changes occurring in the structure of agglomerates affect the temperature characteristics during the subsequent thermal explosion.

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