Development of Aluminum Matrix Composites with Non-agglomerated Nanodiamond Reinforcements

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Abstract

Agglomeration of nanodiamond particles is the main reason for their restricted industrial application. Mechanical alloying during production allows agglomerates splitting [1-3] and even distribution of non-agglomerated nanodiamond particles in the metal matrix, including the one made of aluminum alloys. But as a result of aluminum and nanodiamond mixture processing in a planetary mill for more than 8 hours, aluminum carbide can be formed (Fig.1). To avoid this, shorter processing time is required that is impossible under some circumstances. It was suggested that the main agglomerates splitting operation should be performed during copper or zinc matrix composite production (in the event that these metals are included into the required alloy), followed by processing with aluminum. In this case the period of processing a composite containing aluminum is reduced 5-7 times.

Research has showed that intermediate production of a copper or zinc matrix composites allows complete splitting of nanodiamond agglomerates and their even distribution in the matrix (Fig.2). Further 100-120 minute joint processing with aluminum powder allows obtaining even distribution of non-agglomerated nanodiamond particles within an aluminum alloy.

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References

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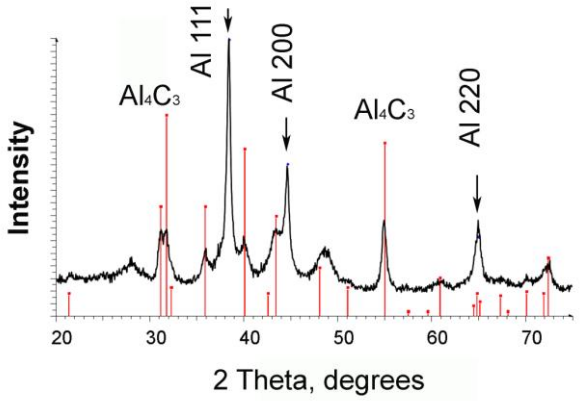

Figure 1. X-ray diffraction patterns from composite “Aluminum + nanodiamonds” after 8h treatment in planetary mill: vertical lines mark aluminum carbide peaks

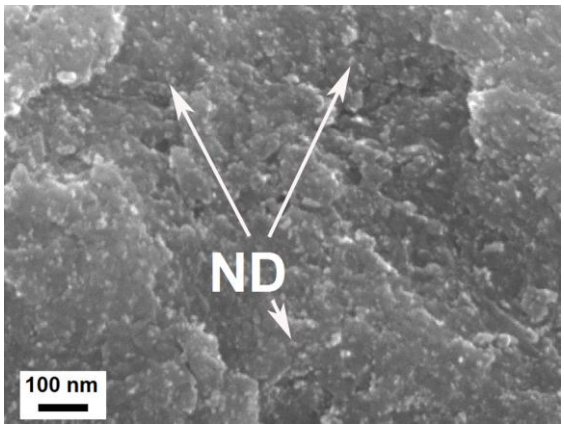

Figure 2. Granule surface of composite “Copper + nanodiamonds” after 4h treatment in planetary mill: arrows mark non-agglomerated nanodiamond particles