

Influence of phase transformations in metal matrix composites during mechanical alloying on intensification of nanodiamond reinforcing particles agglomerates destruction

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Abstract

Application of nanodiamonds (ND) for strengthening metal matrix is prospective method of composites improvement [1-4]. Size of nanodiamond particles equals 4-6 nm, but they combine in agglomerates with more big size. Mechanical alloying (treatment in planetary mill) can destroy agglomerates inside metal matrix effectively. But in aluminum matrix, increasing of treatment time can lead to aluminum carbide formation. Investigation shows that phase transformations in metal matrix during mechanical alloying lead to intensification of nanodiamond agglomerates destruction. Fig.1 demonstrates micro-agglomerates of nanodiamonds inside matrix from pure technical grade aluminum after 8 hours treatment in planetary mill. And Fig.2 shows non-agglomerated nanodiamond reinforcing particles uniform distribution in matrix from aluminum and copper mixture (equal parts) after mechanical alloying during 6 hours. Images were obtained by high resolution scanning electron microscopy from cross-sections of composite granules produced by focused ion beam. It is possible to see that phase transformation (i.e. formation of aluminum-copper intermetallic compounds) lead to completely distraction of smallest nanodiamond agglomerates, because this process connects with changes of lattice parameters and lead to formation of additional internal stresses in nano- and micro-areas.

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under the EFEVE project, grant agreement 314582. The author is grateful to A.Prosviryakov and D.Matveev for help with research implementation.

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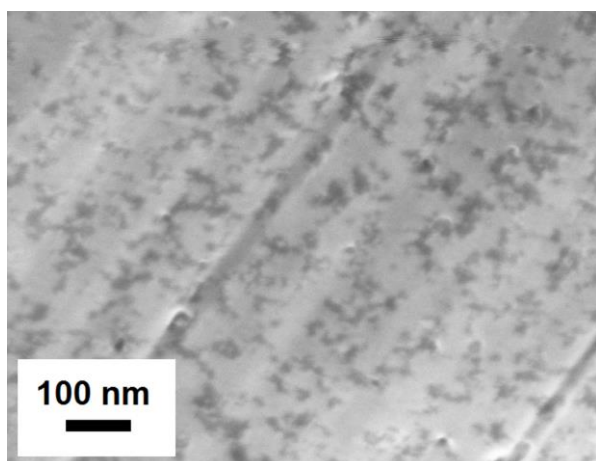


Figure 1. Nanodiamond micro-agglomerates inside matrix from technical grade pure aluminum

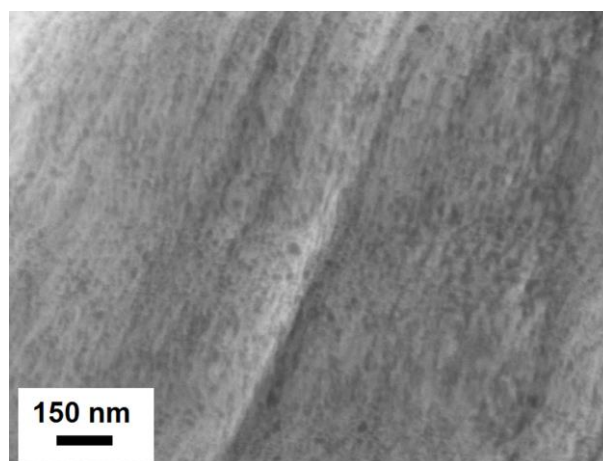


Figure 2. Uniform distribution of non-agglomerated nanodiamond reinforcing particles inside matrix fabricated by mechanical alloying from mixture Al and Cu (equal parts)