Nanocomposites and nanomaterials

On the advanced mechanical properties of Fe-Cu and Y-Cu nanocomposites obtained by mechanical alloying

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In this study Fe-Cu and Y-Cu nanocomposites have been synthesized by mechanical alloying of the elemental equiatomic powder mixture of iron, copper and yttrium in a high energy planetary ball mill under argon atmosphere. Microstructure of materials obtained has been studied by use of the scanning electron microscopy. Phase transformations in composite materials obtained have been studied by X-ray powder diffraction methods. The metastable -(Fe,Cu) supersaturated solid solution is formed in the Fe-Cu nanocomposites during milling process, while the phase transformation during milling of the equiatomic Y-Cu charge follows the reaction: Y + Cu YCu + YCu_2. All materials obtained demonstrate advanced mechanical properties. A set of mechanical characteristics' measurements has been carried out using a method of continuous indentation (the standard Berkovich diamond pyramid) at different load with registration of an indentation diagram (dependence of the load on the depths of the pyramid's penetration) by the Micron-Gamma equipment. The indentation performed gives us a possibility to calculate the Young's modulus of materials studied. In particular, an increased microhardness value of YCu nanocomposite obtained by powder metallurgy route is almost twice as high as that of bulk YCu obtained by arc melting. Besides, this material is characterized by relatively low value of the Young's modulus. Such impressive result is mostly due to the grain's refinement during milling.