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Decomposition and Crystallization Induced by Mechanical Milling

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Abstract

The structural evolution of an amorphous $Fe_{90}Zr_{10}$ alloy under high-energy mechanical deformations was investigated by means of X-ray diffraction, Moessbauer spectroscopy and magnetic measurements. Ball milling of melt-spun $Fe_{90}Zr_{10}$ ribbons in a planetary ball mill induces their crystallization into supersaturated a-Fe(Zr) grains. The decomposition degree of the amorphous phase increases with increasing milling time, with a fully crystalline state being obtained after 30 min at a milling speed of 1000 rpm.

Moessbauer spectra and saturation magnetization measurements suggest that the remaining Zr atoms are most likely segregated at the grain boundaries. Analyses of samples milled at different speeds reveal that the decomposition degree of the amorphous phase increases upon increasing the dose of mechanical energy supplied to the sample.

The decomposition behavior of CoSn and $CoIn_2$ intermetallics under high-energy ball-milling has been investigated using X-ray diffraction, calorimetric and magnetization measurements. Upon milling of the CoSn intermetallic, which decomposes into Co_3Sn_2 and Sn. It is suggested that the mechanically driven decomposition of CoSn results from local melting of powder particles due to high temperature pulses during ball collisions. In contrast to CoSn, $CoIn_2$ does not decompose at all upon milling. The different decomposition behaviors of the studied intermetallics may be attributed to the volume changes occurring with a decomposition process. Whereas the decomposition of CoSn into their product phases results in a strongly negative volume change, the decomposition of $CoIn_2$ leads to an increase in volume. Hence, high local stresses under ball collisions are expected to make the mechanically induced decomposition of CoSn favorable but rather hinder the decomposition of $CoIn_2$.

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Synthesis of Titanium Carbide by Heat Treatment of TiH2 and Carbon Powders

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Abstract

Most non-oxide ceramic materials have advantages of high strength even at high temperature, high wear resistance, low thermal expansion coefficient, and light weight. Titanium carbide(TiC) is a materials of commercial interest because it possesses a range of desirable properties. It is one of the hardest known metal carbides, has a low density and relatively high thermal and electrical conductivity.

In this study, used raw powders were TiH2 and carbon black. The ratio of TiH2 and C(carbon black) were 1:1 (mol) and milled by a planetary ball mill at a ball-to-powder weight ratio of 20:1. Thereafter, DTA was performed between 20℃ and 1400℃ to observe change of phase with milling time. Titanium carbide was obtained by heat treatment at 1100-1200℃. The lattice parameter increases with reaction temperature. In case that heat treatment is 1100℃, lattice parameter of titanium carbide is 0.4311nm and exactly matched JC-PDS card. Particle shape changed square over 1200℃ because of abnormal grain growth.