CHARACTERIZATION OF MECHANICALLY ALLOYED FeAlSi INTERMETALLIC POWDERS

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Powder metallurgy is very promising material production technology which allows to prepare the alloys that could hardly be manufactured by other processing route. Basic prerequisite to obtain the product of desired properties is the high quality of initial primary commodities, i.e. powders in the case of powder metallurgy. One of the available methods of powder preparation is so called mechanical alloying which starts from blended powder mixtures and allows production of homogeneous materials by severe deformation in a high-energy ball charge. This technology is especially suitable for brittle materials such as intermetallic alloys being developed for high-temperature and corrosive environments applications [1].

The contribution focuses on the characterization of intermetallic FeAlSi powders prepared by mechanical alloying which are consequently compacted to form the final product by spark plasma sintering. This type of alloys is used in high-temperature application in aggressive environments [2].

Microstructural and mechanical characteristics of the powders prepared from different initial feedstock materials (Fe, Al, Si, FeAl, AlSi, Fe_3Si) were studied during whole process of mechanical alloying (milling times from 1 to 24 hours). SEM, TEM, XRD and nanoindentation were used to evaluate progressive homogenization of the powders with increasing milling time and the time for the complete homogenization of the studied powders was estimated. Finite element simulations were performed to understand the contributions of the particle size and shape on the measured values of hardness and Young´s modulus. It was found that the change of the input initial powders (even if the final composition stays unchanged) can have significant effect on the kinetics of the mechanical alloying and the time necessary for the preparation of the powder suitable for the compaction can be different. Optimization of the process can lead to important time and economic savings.

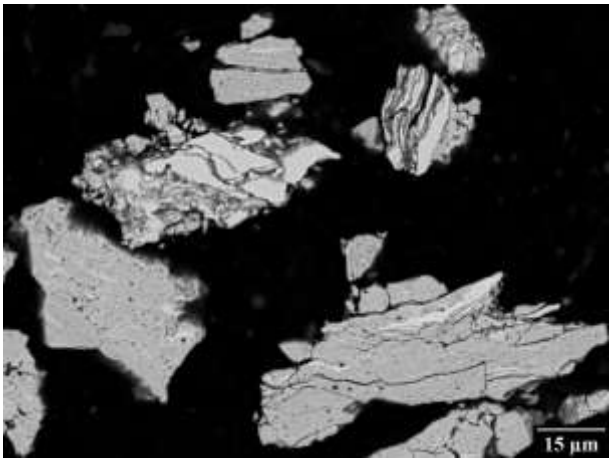

Figure 1 – Mechanically alloyed powder particles in different state of homogenization.

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