

METASTABLE NANOMATERIALS AND NANOCOMPOSITES OBTAINED BY HIGH PRESSURE TORSION POWDER CONSOLIDATION

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Nanostructuring can dramatically improve the mechanical and functional properties of metallic materials and composites and to achieve the goal of a nanostructured bulk material innovative techniques have to be used.

High Pressure Torsion (HPT), a method of Severe Plastic Deformation (SPD) is a novel processing route for powder consolidation, featuring a complete absence of a sintering treatment – bulk samples are the direct result of the SPD process. HPT further shows two advantages: First, the starting material (powder mixtures) can be processed at any concentration. Even immiscible compositions were successfully processed for different systems (e.g. Cu-Fe, Cu-Co). Second, the severe deformation gives rise to supersaturated solid solutions (“far from equilibrium”) yielding interesting material properties, different from the pure or alloyed elements’ ones.

These supersaturated solid solutions, upon adequate annealing, show phase separations yielding nanoscaled composites. This gives a tool in one’s hands to systematically tune certain material properties. The nanostructures that were formed in such a way show high strength and ductility but also interesting functional properties. To give an example, annealing of above mentioned binary systems changes their magnetic properties regarding coercivity, remanence and magnetoresistance.

Thus, combining the right choice of processed powders (composition, size, shape), HPT-processing parameters (applied strain, processing temperatures) and subsequent annealing treatment (time, temperature) results in desired, tailored microstructures of optimized properties.

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