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Shock compression response of ferromagnetic FePt nanoparticles
Z.Q. JIN, University of Texas at Arlington, J. LI, N.N. THADHANI, Z.L. WANG, Georgia Institute of Technology, T. VEDANTAM, J.P. LIU, University of Texas at Arlington — The shock-compression response of ferromagnetic FePt nanoparticles has been studied with the objective of making bulk nanocrystalline permanent magnets. Chemically synthesized FePt nanoparticles (10 nm size) with a partially ordered fct structure, produced after controlled thermal annealing at low temperature, were pressed to ∼45% packing density and shock consolidated using a three-capsule plate-impact gas-gun fixture. The recovered disk-shaped magnets were densified to a density of ∼90% higher than the initial packing density via intensive plastic deformation of the nano-sized particles, as revealed by high resolution transmission electron microscopy. Shock compression of the nanoparticles also induced an order-to-disorder phase transition from fct to fcc structure. The disordering transition resulted in decrease of magnetic properties; however, upon subsequent annealing, the ordered structure was completely recovered and the 10 nm grain size was still fully retained. The samples showed properties with characteristics of hard magnets - energy product $(BH)_{max}$up to 14 MGOe and coercivity up to 14.6 kOe, which are higher than those of un-shocked samples. This work has been supported by US DoD/DARPA through ARO under grant DAAD-19-01-1-0546.

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