Compressibility of nanostructured Fe – Cu materials prepared by mechanical milling

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High-energy ball milling is widely used for the preparation of materials, which are far from equilibrium, e.g. nanostructured, amorphous, and supersaturated alloys and ceramics. Compressibility of nanostructured Fe-Cu materials has been investigated by in-situ high pressure x-ray diffraction using synchrotron radiation. It is found that the bulk modulus of both fcc- Cu- and bcc-Fe phases decreases with decreasing grain sizes. In contrast, small amount dopants, i.e. Fe in fcc-Cu and Cu in bcc-Fe, increase the bulk modulus of the metal matrix. The unstable ferromagnetic fcc-FeCu solid solution prepared by mechanical alloying has a bulk modulus of about 85 GPa which is much smaller than the corresponding values for bulk fcc-Cu and bcc-Fe.

Figure 1: Compression curves for Fe-Cu samples milled for 20 h and 100 h, respectively. The full curves have been calculated from the equation of state

This work was supported by the TMR-Contract ERBFMGECT950059 of the European Community. The results were reported at the 4th International Conference on Nanostructured Materials, June 14-19, 1998, Stockholm, Sweden.