Magnetic and structural properties of Fe_5SiB_2 under pressure

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In recent years the search for new materials suitable for preparation of rare-earth free permanent magnet has led to renewed interest in the magnetic properties of Fe compounds with anisotropic crystal structure which can promise sizeable magnetic anisotropy and high Curie temperature.

The Fe_5SiB_2 phase was discovered in 1960 by B. Aronsson and I. Engström. It possess a high Curie temperature of 845 K and high value of saturated magnetization of about 9 μ_B/f.u.. The compound crystallizes in the tetragonal crystal structure of Cr_5B_3 type with lattice parameters of about a = 5.43 Å and c = 10.33 Å [1-5]. Unfortunately, the resulting magnetic anisotropy is not sufficient to present high coercivity. The magnetic properties were previously studied by chemical substitution which can lead to significant changes of saturated magnetization and magnetic anisotropy [2,4,5]. The pure Fe_5SiB_2 has uniaxial magnetocrystaline anisotropy (at room temperature) and it undergoes a spin-reorientation transition at temperatures below 200 K to easy-pale anisotropy. At present the compound does not exhibit properties suitable for application though it is a very interesting compound for studying the magneto-structural relations and pressure/volume effects on magnetic properties. The previous experimental and theoretical studies on the effect of chemical substitutions, particularly volume variation and fix spin moment calculation motivated us to connect this approach by following the effects of applied pressure on magnetic and structural properties. In this work we present the evolution of the unit cell parameter a and c under pressure up to 6 GPa and on temperature down to 10 K at ambient pressure as well as the evolution of saturated magnetization under hydrostatic pressure up to 1 GPa. The pressure evolution of the spin reorientation occurring at low temperature is also studied. The obtained value of bulk modulus of 124 GPa allows us to compare the effect of pressure with previously studied effects of chemical substitution. The determined V-P diagram is presented on figure 1.

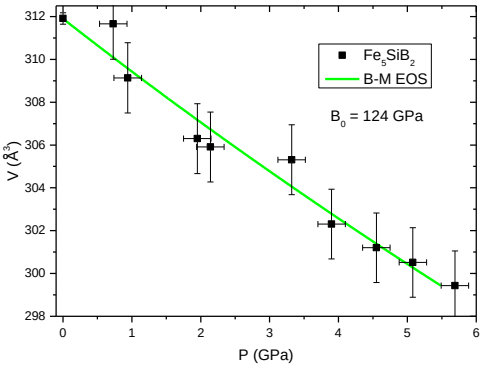

Figure 1. V-P diagram determined using XRD under pressure at room temperature. The obtained data was fitted by Birch-Murnaghen equation of state (green line).

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