ABSTRACT CODE

Crystallographic and magnetic characterization of the uranium intermetallic compound UFe_7Al_5

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The AFe_xAl_{12-x} (A=f-element) series is the most widely investigated among the $ThMn_{12}$-type structure families. This series was primarily studied on polycrystalline samples with rare-earths, and later with actinides. The Al concentration necessary to stabilise these compounds is relatively high, usually more than 50%. In UFe_xAl_{12-x} the phase relations indicated a congruent melting composition range between $UFe_{3.8}Al_{8.2}$ and $UFe_{5.8}Al_{6.2}$ [1]. The magnetic phase diagram of this system was previously determined in this composition range, and four magnetic regions were identified, with two transitions in the range $4 \leq x < 5$ [2]. Previous measurements on UFe_5Al_7 and UFe_6Al_6 indicated a ferromagnetic character for both compositions, and powder neutron diffraction results suggested that the Fe moments are ferromagnetically ordered in a configuration perpendicular to the *c* axis [3]. More recently we found that it is possible to obtain almost single-phase samples with a higher Fe concentration.

The ternary compound UFe_7Al_5 was synthesized by arc melting, followed by annealing at 850ºC. It crystallizes in the $ThMn_{12}$-type structure (a=8.581(2)Å, c=4.946(1)Å, R=0.039), being a new extreme composition in this family of intermetallics. In contrast to other UFe_xAl_{12-x} with $4 \leq x \leq 6$, in UFe_7Al_5 the additional Fe atom is not going to the 8*j* but to the 8*i* sites. M(T) measurements show two magnetic transitions at 363 K and 275 K respectively. Below 363 K, the M(H) curves are typical of a ferromagnet, with the spontaneous magnetization for T=0 being $m_S=8.5\mu_B$/f.u..

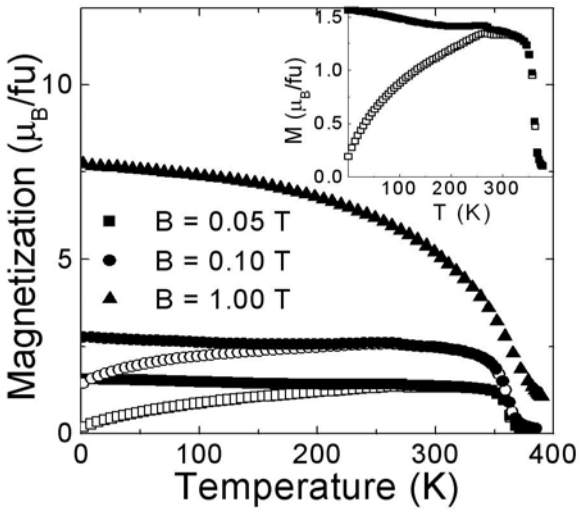

Fig. 1. Magnetization *versus* temperature in UFe_7Al_5.

The magnitude of the higher temperature transition indicates that it is related with the ferromagnetic ordering of the Fe atoms. The anomaly at 268 K can reflect either a rearrangement of the Fe magnetic moments or the ordering of the U moments. Mössbauer data confirms that the first transition is related to the ordering of the Fe atoms. The dependence of the isomer shifts and magnetic hyperfine fields on the crystallographic site and on the number of the Fe nearest neighbours is similar to that observed in other AFe_xAl_{12-x} analogues. The magnetic hyperfine field values of Fe atoms on 8*i* sites is larger than in the other sites, in agreement with previous data obtained for other $ThMn_{12}$-type compounds.

References

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