CRITICAL SLOWING DOWN OF THE SPIN RELAXATION IN NANOCLUSTERED FE-AL-B ALLOYS

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A vast number of heterogeneous magnetic systems, which are the subject of present scientific and technological attention, display disordered magnetic arrangements as a result of spatial and/or anisotropy randomness and competition between interactions of different sign. The magnetic relaxation of atomic spins (or the macrospin of nanoparticles) slows down upon cooling and, under certain conditions, finally collectively freeze in a spatially uncorrelated magnetic configuration, called the spin-glass (or superspin-glass) state [1-4]. The superspin freezing temperature will depend on the particle size and concentration, and also on the matrix nature [2]. The terms *superspin-glass* (SSG), or *superferromagnet*, were coined analogously to the older term *superparamagnetism*: the prefix "super" expresses the substitution of the atomic spin by a particle magnetic moment of several hundreds/thousands Bohr magnetons, with the particle ensembles retaining, nonetheless, the essential magnetic behavior of the corresponding atomic-spin scenario (paramagnetism, ferromagnetism, or spin-glass), only with higher transition temperatures from the collective low temperature states to the superparamagnetic regime [4]. These terms have been applied in relatively different solids such as ultrafine monodispersed Fe-C particles [5] and $Co_{80}Fe_{20}/Al_2O_3$ discontinuous multilayers [6]. Recently, it has been shown than Fe-based alloys (around 30% Fe) obtained by milling exhibit SSG behavior [7-10], where the cluster diameter was estimated to be as small as 1 nm, similarly to other less Fe-concentrated alloys .

A highly disordered alloy of $Fe_{35}Al_{50}B_{15}$ has been produced by milling under vacuum for 840 hours, with the X-ray diffraction pattern showing only two broad peaks. The AC-susceptibility shows sharp maxima around 20 K (21 K) in the real (complex) components. Those are due to spin freezing, and shift up in temperature when the frequency is increased. The magnetic dynamics is accounted for by a critical slowing down with zv = 8.0(4) and T_0 = 19.8(2). The large dynamic exponent β = 1.3(1) is an indication of a non-conventional transition. The non-linear susceptibility reveals a peak with γ = 1.2(4) which is affected by the oscillating h < 5 Oe and biasing ($H_{DC} \leq$ 40 Oe) fields. The results are interpreted in terms of the collective blocking of very fine Fe-rich magnetic particles resulting from an incomplete compositional homogenization

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