Random Spin Freezing in Single Crystalline Ce_2CuSi_3

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Nonmagnetic atom disorder compounds Ce_2CuSi_3 crystallizing in a hexagonal AlB_2-type structure is a very interesting example among the ternary intermetallic compounds with composition 2:1:3. We have reported the discovery of spin glass (SG) behavior with extended short-range magnetic order for a polycrystalline Ce_2CuSi_3. Considering the SG behavior is very sensitive to the levels of crystallographic disorder, in order to get an intrinsic and complete physical picture and to open up the possibility of studying magnetic anisotropy of Ce_2CuSi_3, systematic investigation on single crystalline sample is indispensable. In this paper, we present the results of ac and dc susceptibilities, magnetization, magnetic relaxation and specific heat measurements performed on single crystalline Ce_2CuSi_3 with magnetic field applied along two typical crystallographic directions, i.e. $H \perp c$-axis and $H \parallel c$-axis. For both the directions, SG state is confirmed to form at low temperature with the same spin freezing temperature T_f(=2.07 K), initial frequency shift δT_f(=0.015) and activation energy E_a/k_B(=10.04 K) in zero dc field. Strong anisotropy is also found to be a significant feature of this compound. The experimental results and the dynamical analyses suggest that the SG behavior is intrinsic to Ce_2CuSi_3 which could be qualitatively understood on the basis of a magnetic cluster model.