

Peculiar Magnetic Properties of Co₂CrAl Heusler Alloy

K. W. Kim¹, Y. V. Kudryavtsev², J. Y. Rhee³, T. W. Eom⁴, and Y. P. Lee⁴

¹Sunmoon University, Asan, Korea, ²Institute of Metal Physics, Kiev, Ukraine,

³Sungkyunkwan University, Suwon, Korea, ⁴Hanyang University, Seoul, Korea

Bulk Co₂CrAl alloy was prepared by melting high purity elements (99.99%) in an arc furnace with a water-cooled Cu hearth. The ingot was remelted 5 times and annealed at 1273 K for 10 h in vacuum to promote the volume homogeneity. No weight loss after melting and heat treatment was observed. The alloy composition was confirmed by x-ray fluorescence. Co₂CrAl alloy films were prepared by flash evaporation of the crushed alloy powders of 80 - 100 μm in diameter onto glass substrates in a vacuum better than 2×10^{-5} Pa. The alloy powders were prepared from the same ingot of bulk Co₂CrAl alloy. To enhance the crystallinity of film, the substrate was kept at 708 K during deposition (film 1). Another film was deposited at 150 K and post annealed at 760 K for 10 min (film 2). The thicknesses of films are 135 and 153 nm for film 1 and 2, respectively. The magnetic properties were investigated in a temperature range of $5 \leq T \leq 350$ K using a SQUID magnetometer for the samples cooled in field-cooled (FC) and zero-field-cooled (ZFC) modes, respectively.

The FC magnetization is typical for the ferromagnetic material, while the ZFC magnetization exhibits a giant negative magnetization (NM) at low temperatures and the magnetization direction is flipped abruptly at a certain temperature upon heating. The magnitude of NM is comparable to that of the FC magnetization at the same temperature. The flipping temperature strongly depends on the field strength. We attribute this giant NM to the interplay between Landau diamagnetism and peculiar electronic structures which are closely related to the half-metallicity of Co₂CrAl Heusler alloy.