Magnetization Behavior of Ultra-thin Fe_xCo_{1-x} Alloy on Cr (100) Surface

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Abstract: Magnetization behavior of ultra thin Fe_xCo_{1-x} alloy (where x varies from 0 to 100) has been investigated as functions of composition on Cr (100) substrate by using in situ surface magneto optical Kerr effect (SMOKE). It's always show in plane uniaxial magnetic anisotropy at room temperature (RT) & Low temperature (LT). It is observed that composition dependent coercive force maximum at about 30 at % Co and 70 at % Co atomic ratio and minimum near equiatomic site. The relative magnetic moments as composition variation also show magnetization collapse near equiatomic site. The magnetization behaviors of Fe-Co alloy on Cr (100) due to composition varies are supported the order-disordering as well as structural stability bcc (ferromagnetic)/ fcc (anti-ferromagnetic) phase stability magnetism.

Keywords: Fe-Co alloy, Coercive force, Magnetic moment, ordering-disordering phase & Spin polarization.

1. Experiments

The experiments were performed on the ultrahigh vacuum (UHV) systems. The Cr (100) crystal surface was cleaned using 1KV Ar ions sputtering and subsequently annealed at 900K. Magnetization measured using the surface magneto optical Kerr effect (SMOKE) that was conducted on UHV with He-Ne laser (632nm wavelength).

2. Results

The coercive force curve as composition varies shown in (**fig** 1). It is observed that the maximum coercive force near at 30 at % Co and 70 at % Co and gradually decrease near equiatomic site.

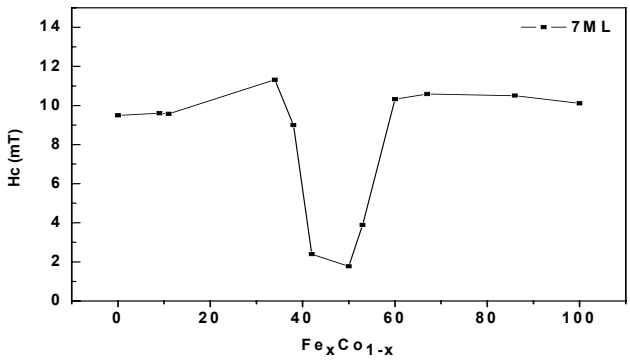

Fig. (1); Coercive force of Fe_xCo_{1-x} / Cr (100) at RT.

In fig (2) we attempt to a quantitative comparison of relative magnetic moment of Fe_xCo_{1-x} alloy. It shows maximum magnetic moment near at 30 at % of Co and 70 at % Co and then gradually decreases near equiatomic composition.

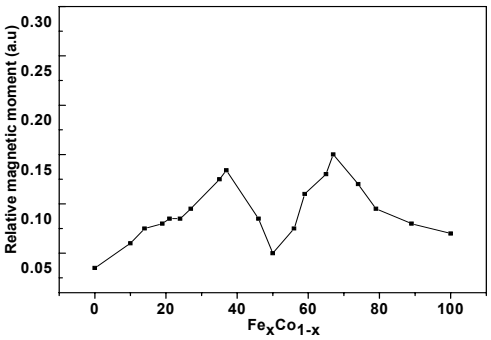

Fig. (2); Relative magnetic moment of 7ML Fe_xCo_{1-x} / Cr (100) at RT.

3. Discussions

The electronic and magnetic behaviors of FeCo alloy has lots of information on Slate-Pauling curve regarding on bulk metal alloy. It shows a linear increase of the average magnetic moment as a function of the increasing electron per atom ratio, maximum occurs at a 50:50 alloy composition which is not observed experimentally. In fact, the Co moment remains approximately constant over the whole composition range and the moment Fe varies significantly that accounts for the maximum in the Slater-Pauling curve at around 30 at % Co [2]. In this case we can extend our idea on structural induce magnetic properties of thin FeCo alloy. J.A.Oyedele et. al. [3] shows ordering-disordering phase transition effectively near equiatomic site. I.Ohnuma et. al. [4] confirmed from their experiment that the two phase region between the b.c.c and f.c.c γ(A1) phase exists on the α(A2)/α′(B2) ordering –disordering boundary and very sensitive for thin Fe-Co alloy . In fcc phase exist as ferromagnetic or antiferromagnetic depend on lattice constant. Fe-Co alloy changed their lattice constant as function of composition varies [5]. In theory there is another observation that it absorbed high spin (HS) and low spin (LS) due to the structure change as composition varies at 45% of Co [6].

4. Conclusion

In the summery the Fe_xCo_{1-x} alloy on Cr (100) substrate always shows in plane magnetization. The coercive force shows maximum near at 30 at % Co and 70 at % Co and gradually decreases near at equiatomic site. These magnetizations behaviors for composition dependent might occur due to spin polarization, structural change, ordering-disordering phase as bcc/fcc and surface ground state properties through d- hole filling mechanism of Fe-Co alloy.

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