[IV~6]

Study of the Structure Change on Ion-Beam-Mixed CoPt Alloys.

J.H.Son, Y.S.Lee, K.Y.Lim, T.G.Kim, G.S.Chang, J.J.Woo[1], C.N.Whang

Department of Physics & Atomic-scale Surface Science Research Center,
Yonsei University, Seoul 120-749, Korea.
[1]Department of Physics, Chonnam National University, Kwangju, 500-757, Korea.

Abstract

By the ion bombardment, the original discrete layered structure is damaged, and a uniformly mixed layer is formed by the intermixing of the films. Immediately after this dynamic cascade mixing, a structure of this mixed layer is likely to be a mixture of randomly distributed atoms. Subsequently, the mixed layered structure becomes a non-equilibrium structure such as the metastable phase because the kinetic energies of the incident ions rapidly dissipate, and host atoms within the collision cascade region are quenched from a highly energetic state. The formation of the metastable transition metal alloys using ion-beam-mixing has been extensively studied for many years because of their specific properties that differ from those of bulk materials. In ion-beam-mixing, the alloy or compound is formed due to the atomic interaction between different species during ion bombardment.

In this study, the metastable phase formed by ion-beam-mixing process is compared with equilibrium one by arc-melting method by GXRD and XAS. Therfore, we studied the fundamental characteristics of charge redistribution upon alloying and formation of intermetallic compounds.

The multi-layer films were deposited on a wet-oxidized Si(100) substrate by sequential electron beam evaporation at a pressure of less than 5×10^{-7} Torr during deposition. These comprise 4 pairs of Co and Pt layers, where thicknesses of each layer were varied in order to change the alloy composition.

Ion-beam-mixing was carried out with 80 keV Ar^+ ions with a dose of 1.5×10^{16} Ar^+/cm^2 at room temperature.

The atomic structure were studied by glancing angle x-ray diffraction(GXRD) with the atomic concentration. In order to understand the electronic by atomic structure change, Co K-edges and Pt L_3-edge XANES spectra were measured at the 3C1 beam line of the PLS(Pohang Light Source).

From the GXRD results, we show that the ion-beam-mixed Co-Pt systems are the disordered alloys at all composition but the arc-melted systems are ordered alloys, such as $CoPt_3$, and CoPt alloys. The phases of ion-beam-mixed Co-Pt systems were similar with the ones which were quenched from annealing at high temperature.

In Co K-edges and Pt L_3-edges XANES spectra for ion-beam-mixed and are-melted Co-Pt alloys, we show that Pt L_3-edge WL area is decreasing and Co K- edge WL area is increasing upon alloying. These results are mean that Co *p* bands are reduced as the Pt content is increased upon alloying, on the other hand, Pt 5*d* bands are increased with decreasing Co concentration.

☞ This work was supported by BSRI program (BSRI-97-2426) and the KOSEF through the Atomic-scale Surface Science Research Center at Yonsei University.