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Formation of a Bilayer Ordered Surface Alloy of Mn Thin Films

W. Kim, J. Seo*, J.-S. Kim** and S.-J. Oh
Department of Physics, Seoul National University
*Division of General Education, Chodang University
**Department of Physics, Sook-Myung Women's University

We report a new type of surface alloy, the formation of a bilayer ordered surface alloy of Mn thin films deposited on some transition metal (100) surfaces, from the results of Low-energy electron diffraction(LEED) I/V analyses. For Mn on Ag(100), very sharp and bright c(2x2) LEED pattern is observed with norminal 1 monolayer Mn deposited, and the experimental I/V curve is well fitted only by a model, a bilayer ordered surface alloy structure with little corrugation of Mn atom. Sudden disappearance of c(2x2) pattern is, however, observed on light annealing at 400K. By analyses on atomic compositions of each layer using averaged t-matrix approximation(ATA), we find out that vanishment of LEED superstructure is due to the segregation of Ag atoms. For the case of Mn on Pd(100), we achieve more improved fitting of the experimental I/V curves by employing a bilayer ordered surface alloy instead of the single layer ordered alloy model which was tried in the previous study of Tian et. al.[1] However, unlike the Mn atoms deposited on Ag(100) surface, the topmost Mn atoms in this system are severely buckled out from the surface and its amount of corrugation is comparable to that of Mn/Cu(100) system. Thermodynamic property is also different:More clear c(2x2) LEED pattern is obtained after annealing. Mn 3s core level spectra of both systems show exchange splittings similar with that of bulk Mn, so magnetic effect on surface alloying is important in common with two cases. The distinctive characteristics of these two systems belonging to the same class of surface alloy, can be understood qualitatively, considering the differences in surface free energy and atomic size effect between Ag and Pd.

[References]

1. D. Tian, R.F. Lin, F. Jona, and P.M. Marcus, Solid State Commun. Vol. 74, 1017(1990)