A helium atom diffraction study of the epitaxial growth of cobalt on Cu(100)

1989 J. Phys.: Condens. Matter 1 SB177

(http://iopscience.iop.org/0953-8984/1/SB/030)

J. Phys.: Condens. Matter **1** (1989) SB177–SB178. Printed in the UK

A helium atom diffraction study of the epitaxial growth of cobalt on Cu(100)

John Ellis, Elaine M McCash and William Allison

Cavendish Laboratory, Department of Physics, University of Cambridge, Madingley Rd, Cambridge CB3 0HE, UK

Received 23 March 1989

Abstract. Between 247 and 327 K cobalt grows epitaxially on Cu(100), with a smaller diffusion coefficient for cobalt on copper than for cobalt on cobalt. It is possible to grow ten monolayers of cobalt on Cu(100) before strain in the layers causes the defect density to rise. Above 347 K growth is perturbed—probably by inter-diffusion.

Figure 1 shows the in-phase and out-of-phase growth curves for the deposition of cobalt on a copper(100) single crystal. Cobalt grows in an almost ideal 2D layer-by-layer mode on Cu(100) at substrate temperatures between 247 and 327K, adopting the FCC structure of the bulk copper, rather than the usual hexagonal Co lattice [1]. It is found that smaller terrace sizes are observed for the first cobalt layer than for subsequent layers, indicating that there is a smaller adatom diffusion coefficient for cobalt adatoms on the clean Cu(100) surface compared to that for on the cobalt-covered surface.

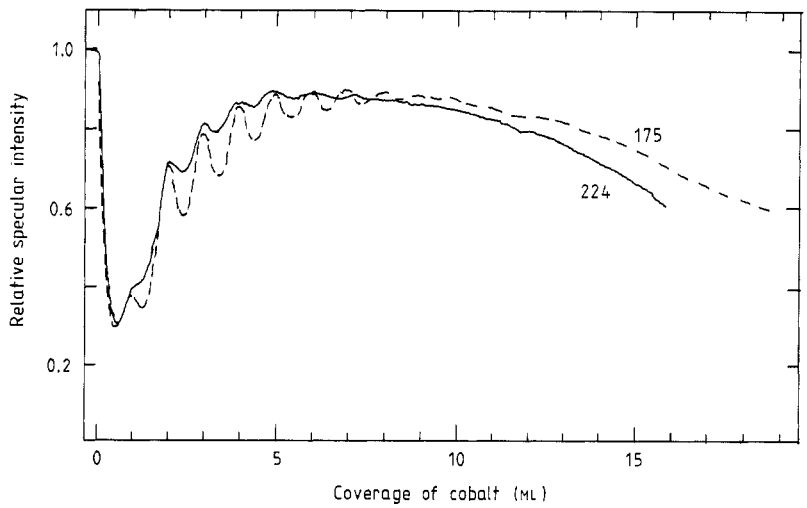

Figure 1. The relative specular intensity measured as a function of cobalt coverage for cobalt growth on Cu(100) at 298 K. The deposition rates are given on the curves (in seconds per monolayer). Full curve: in-phase scattering; broken curve: out-of-phase scattering.

The diffusion coefficient of cobalt adatoms on a cobalt-covered Cu(100) surface has an activation energy of 0.53 eV and a pre-exponential value of $3.5 cm^2 s^{-1}$, both values being smaller than those for the diffusion coefficient of copper adatoms on a clean Cu(100) surface.

The specular intensity for both the in-phase and out-of-phase conditions began to decay after about ten monolayers of cobalt had been deposited, because the strain in the layers built up and caused the defect density to rise. At growth temperatures above 347 K, a new phenomenon, probably inter-diffusion, occurs and perturbs the layers.

Reference

[1] Clarke A, Jennings G, Willis R F, Rous P J and Pendry J B 1987 *Surf. Sci.* **187** 327