ELECTRONIC PROPERTIES OF TWO-DIMENSIONAL SYSTEMS

PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON ELECTRONIC PROPERTIES OF TWO-DIMENSIONAL SYSTEMS

COLBY–SAWYER COLLEGE
NEW LONDON, NEW HAMPSHIRE, USA
24–28 AUGUST 1981

Guest Editor:

FRANK STERN

IBM Thomas J. Watson Research Center
Yorktown Heights, New York

1982

NORTH-HOLLAND PUBLISHING COMPANY — AMSTERDAM

Surface Science 113 (1982) 443–453
North-Holland Publishing Company

STRUCTURE AND PHYSICAL PROPERTIES OF SPUTTERED METALLIC SUPERLATTICES

Ivan K. SCHULLER and Charles M. FALCO

Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439, USA

Received 15 July 1981; accepted for publication 27 August 1981

The technique of preparing metallic superlattices by sputtering is described as are the results of a calculation of the energy distribution of sputtered atoms. Structural studies by X-ray diffraction, Ion Mill Auger Electron Spectroscopy and Ion Mill Ion Scattering Spectroscopy all indicate well defined layer structure for the Nb/Cu system. The resistivity of Nb/Cu and Nb/Ti and the superconductivity of Nb/Cu are all found to be dependent upon the layered nature of the material.

1. Introduction

The study of two-dimensional metal physics has been dependent on the requirement of reliably preparing ultrathin (a few atomic planes thick) single films of metals. Due to contamination (e.g. oxidation) and because of inherent problems in the structure (aglomeration) and handling of such thin films, the physical properties of such films normally have to be measured in situ. This of course poses a large number of experimental difficulties and restricts the variety of physical properties that can be measured on identical samples. A possible alternative for the study of such two dimensional properties is the preparation of multilayered films. In this fashion it is possible to study the physical properties of thin metal films when they are separated by a suitable metal, semiconductor or insulator [1]. In addition, by varying the thickness of the "separator" it is feasible to investigate the transition to three-dimensional behavior. As we will show, many of the difficulties encountered using surface analysis techniques (i.e. Ion Mill Auger, Ion Scattering Spectroscopy, etc.) in characterizing thin metal films can be avoided by taking advantage of the long range order existent in metallic superlattices. We will describe here the structural and novel physical properties of the Nb/Cu and Nb/Ti metallic superlattices.

2. Preparation techniques

The materials described in the present paper have been prepared using a sputtering technique developed by us. Two high rate magnetron sputtering

0039-6028/82/0000–0000/$02.75