THE STRUCTURE OF RARE-EARTH METAL SURFACES

S. D. Barrett

University of Liverpool, UK

S. S. Dhesi

European Synchrotron Radiation Facility, France

ICP

Imperial College Press

CONTENTS

PREFACE

The Structure of Rare–Earth Metal Surfaces outlines the experimental techniques and theoretical calculations employed in the study of the atomic and nanoscale structure of surfaces and reviews their application to the surfaces of the rare–earth metals. In particular, the results of quantitative low–energy electron diffraction experiments and multiple–scattering calculations are covered in some detail due to their importance in the field of surface structure determination.

The aim of the book is two–fold. Firstly, it can be used by those new to the field of surface science as an introduction to surface crystallography, covering the basic principles and showing many examples of surfaces from a selection of elements from the periodic table. Secondly, it can be used as an introduction to the world of the rare–earth metals, and their surfaces in particular, giving a taste of the active research fields that are currently being explored. A full review of all of the many hundreds of studies that have been made of rare–earth metal surfaces is not attempted, as it would be too large a task and beyond the scope of this book. However, we thought that the information tabulated in the appendix, giving references for all studies that have some relevance to rare–earth metal surfaces, would be a valuable source of information for any student embarking on research in this or related fields.

Surface science is, by its very nature, an interdisciplinary science — often no clear boundaries exist between the physics, chemistry and materials science of surfaces. Any that do appear to exist are either imposed artificially or are very ill–defined, or perhaps both. This book may appear to fall into the category of surface physics, as it describes the principles and practice of determining the crystallographic structure of surfaces at the atomic and nanometre scales. However, by describing how the structures of surfaces are intimately linked to their electronic,

magnetic and chemical properties, we show that surface structure cannot be studied in total isolation from these other aspects. We have aimed the book at science graduates with an interest in surface crystallography. Although a background in solid state physics will be helpful to the reader, by not relying too heavily on undergraduate physics we have tried to keep the content at a level such that graduates from disciplines other than physics will not be disadvantaged. Describing the theoretical treatment of surface atomic structure determination will inevitably require some mathematics, but where this is unavoidable the reader is led through the mathematics to see how the physics comes through, sacrificing rigour for clarity where possible.

We cannot give a comprehensive account of all aspects of either surface crystallography or the rare–earth metals, and so further reading paragraphs are provided at the end of some of the sections to guide the reader to review articles or books that give more detailed information on techniques, applications, or related studies.

Steve Barrett
Sarnjeet Dhesi