Chemical Bonding and Spectroscopy in Mineral Chemistry

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Preface

In recent years mineralogy has developed even stronger links with solid-state chemistry and physics and these developments have been accompanied by a trend towards further quantification in the theoretical as well as the experimental aspects of the subject.

The importance of solid-state chemistry to mineralogy was reflected in a symposium held at the 1982 Annual Congress of The Royal Society of Chemistry at which the original versions of most of the contributions to this book were presented. The meeting brought together chemists, geologists and mineralogists all of whom were interested in the application of modern spectroscopic techniques to the study of bonding in minerals. The interdisciplinary nature of the symposium enabled a beneficial exchange of information from the various fields and it was felt that a book presenting reviews of the key areas of the subject would be a useful addition to both the chemical and mineralogical literature.

The field of study which is commonly termed the 'physics and chemistry of minerals' has itself developed very rapidly over recent years. Such rapid development has resulted in many chemists, geologists, geochemists and mineralogists being less familiar than they might wish with the techniques currently available. Central to this field is an understanding of chemical bonding or 'electronic structure' in minerals which has been developed both theoretically and by the use of spectroscopic techniques. The purpose of this book is to outline the fundamental concepts associated with current models of bonding and to serve as an introduction to the techniques which may be applied in this area of mineral chemistry. It is not the intention of the text to provide a laboratory manual for the techniques discussed, neither is it intended that reviews of the literature detailing applications be comprehensive. This book is a starting point from which the interested reader can progress to many of the more detailed accounts cited in the various chapters.

The book begins with a chapter on the use of quantum mechanics in producing models of chemical bonding in minerals. The next two chapters consider the application of X-ray spectroscopy and of electronic absorption spectroscopy and are followed by a chapter on the more specialist technique of luminescence spectroscopy. All of these methods involve the interaction of some form of electromagnetic radiation with the electrons in solids and provide information about the energies and distributions of the electrons. The next two chapters deal largely with the interaction of radiation with atomic nuclei in minerals as in Mössbauer spectroscopy and nuclear magnetic resonance. These techniques generally serve as more indirect, although equally powerful, probes of the electronic structures of solids. The last two chapters deal with the special problems, as regards both theory and experiment, which are posed by opaque minerals and with the applications of spectroscopic methods for the elucidation of the surface properties of minerals.

If the readers of this book are consequently led to look more deeply into the fascinating areas of bonding and spectroscopy in mineral chemistry then our objectives will have been achieved.

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