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Preface

The recent discovery of high-temperature superconductivity in copper-based oxides is an event of major importance not only with respect to the physical phenomenon itself but also because it definitely shows that solid state chemistry, and especially the crystal chemistry of oxides, has a crucial place in the synthesis and understanding of new materials for future applications. The numerous papers published in the field of high T_c superconductors in the last five years demonstrate that the great complexity of these materials necessitates a close collaboration between physicists and solid state chemists.

This book is based to a large extent on our experience of the crystal chemistry of copper oxides, which we have been studying in the laboratory for more than twelve years, but it also summarizes the main results which have been obtained for these compounds in the last five years relating to their spectacular superconducting properties. We have focused on the structure, chemical bonding and nonstoichiometry of these materials, bearing in mind that redox reactions are the key to the optimization of their superconducting properties, owing to the importance of the mixed valence of copper and its Jahn-Teller effect. We have also drawn on studies of extended defects by high-resolution electron microscopy and on their creation by irradiation effects.

Our objective is to reach a very broad audience: students and teachers, physicists and solid state chemists, whether directly or only indirectly involved in the field of superconductivity. Nonspecialists may skip over many details but will find here the main structural types and the main features which govern the nonstoichiometry of copper oxides, and in this way this book will be useful to students and also to "pure" physicists who are more concerned with the physics of superconductivity. Although far from comprehensive, the lists of references will allow solid state chemists working in this field to find basic tools for their investigations.

Such a book could be written not only for copper oxides but also for many other complex oxides, which have already been synthesized and for which one day suprising physical properties will probably be discovered. For these reasons, we would like to recognize here the tremendous pioneering work which has been done before us by solid state chemists and crystallographers in the field of nonstoichiometric oxides.

The first draft of this book was written during August 1988. We are grateful to our families for the sacrifices they made during those holidays and also at other times before and after the discovery of high-temperature superconductivity.

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D. Groult

Caen
June 1991

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