Although acid–base cements have been known since the mid 19th century, and have a wide variety of applications, there has been a failure to recognize them as constituting a single, well-defined class of material. This book remedies the situation by unifying the subject and treating this range of materials as a single class.

These cements are defined as materials that are formed by mixing a basic powder with an acidic liquid, and offer an alternative to polymerization as a method for forming solid substances. They are quick-setting materials, with unusual properties, which find diverse applications as biomaterials and in industry.

Chemistry of Solid State Materials

Acid–base cements

Their biomedical and industrial applications

Chemistry of Solid State Materials

1 Segal: *Chemical synthesis of advanced ceramic materials*
2 Colomban: *Proton conductors*
3 Wilson & Nicholson: *Acid–base cements*

Acid–base cements

Their biomedical and industrial applications

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Dedicated to the past and present members of the
Materials Technology Group at the Laboratory of the
Government Chemist

Contents

Preface

The senior author first became interested in acid–base cements in 1964 when he undertook to examine the deficiencies of the dental silicate cement with a view to improving performance. At that time there was much concern by both dental surgeon and patient at the failure of this aesthetic material which was used to restore front teeth. Indeed, at the time, one correspondent commenting on this problem to a newspaper remarked that although mankind had solved the problem of nuclear energy the same could not be said of the restoration of front teeth. At the time it was supposed that the dental silicate cement was, as its name implied, a silicate cement which set by the formation of silica gel. Structural studies at the Laboratory of the Government Chemist (LGC) soon proved that this view was incorrect and that the cement set by formation of an amorphous aluminium phosphate salt. Thus we became aware of and intrigued by a class of materials that set by an acid–base reaction. It appeared that there was endless scope for the formulation of novel materials based on this concept. And so it proved.

Over the years, from 1964 to date, a team at the LGC, with its expertise in Materials Chemistry, has studied many of the materials described in this book, elucidating structures, setting reactions and behaviour. This experience has formed a strong experimental background against which the book was written. In addition we have maintained contact with leaders in this field throughout the world. We should mention Professor Dennis Smith of Toronto University, who amongst his many achievements invented the adhesive zinc polycarboxylate cement (Chapter 5); Dr G. M. Brauer, who was for many years at the Institute for Materials Research, National Bureau of Standards, Washington, D.C., and is the acknowledged authority on cements formed by the reaction between zinc oxide and phenolic bodies (Chapter 9); and Dr J. H. Sharp of the University of Sheffield, who has developed magnesium phosphate cements (Chapter 6).

In particular we thank Dr J. H. Sharp for supplying original photographs for use in the section on magnesium phosphate cements and for critically reading the draft manuscript and making constructive suggestions. On clinical matters we have benefited from a 20-year collaboration with Dr J. W. McLean OBE.

Our own research at the LGC, while not confined to, has centred on, cements formed by the reactions between acid-decomposable glasses and various cement-forming acids (Chapters 5, 6, 8, 9). One of these materials invented at the LGC, the glass polyalkenoate or glass–ionomer cement, has proved of immense importance. Indeed, so successful has this material been in general dentistry, that the Materials Technology Group earned the Queen's Award for Technology in 1988. This material illustrates the useful combination of properties that can be found in the acid–base cements, for it has the aesthetic appearance of porcelain, the ability to adhere to teeth, and also the ability to release fluoride with its beneficial effect of reducing caries.

We hope that this work will encourage, stimulate and assist others choosing to work in this interesting field.

Alan D. Wilson
John W. Nicholson

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We note the particular contributions of Brian Kent, present Head of the Materials Technology Group, as co-inventor of the glass polyalkenoate cement way back in 1968, and of Dr John McLean OBE in developing clinical applications. It was Surgeon Rear Admiral Holgate CB, OBE, Chief Dental Officer at the Ministry of Health in 1964, who introduced Dr McLean to the Laboratory of the Government Chemist (LGC) to initiate a collaboration that proved so fruitful. Since then there has been constant support from the Department of Health and its various officers and also from the British Technology Group, particularly from G. M. Blunt and R. A. Lane.

Most importantly we acknowledge the contribution of those who worked at that essential place, the laboratory bench, on which everything depends.

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