Book Reviews

Advanced Ceramics and Future Materials: an Introduction to Structures, Properties, Technologies, Methods

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John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK. 2010. 506pp. Illustrated. £80. ISBN 978-3-527-32157-5.

The study of advanced ceramics and more so the application of advanced theoretical principles to the design and development of future materials is clearly a highly specialised task.

The preface discloses that much of the text is derived from lectures, papers and posters presented at the Max-Planck Institut, the University of Stuttgart, including work done at the Pulvermetallurgisches Laboratorium (PLM).

Chapter 1 is extremely brief – three pages of text bolstered by a wodge of 30 brightly coloured prints of modern ceramic objects. It is perhaps common knowledge that modern engineering ceramics are compounds of metallic and/or non-metallic elements – oxides, such as alumina and zirconia; carbides, of silicon, titanium and tungsten; nitrides, silica, cermets and nano phase materials.

Chapter 2 is more substantial and provides a detailed account of chemical, crystal and microstructures. Four types of bonding – ionic, covalent, Van der Waals and metallic forms are identified. A single example of each helps to make the distinction clear. Block, Bragg and Schrodinger mathematical formulations and experimental methods (used to measure atomic spacings) are explained in more detail, than is often the case. Lattice types, crystal types and defect types are sections fully supported by scores of fine crystallographic images. There are, in fact, 103 plates in Chapter 2, the last of which fig. 2.103 shows a bio-compatible ceramic hip joint endoprostheses, made real by a hint of blood and gore. Such joints are said to be far superior to those made of metal.

Chapter 3, Chemical, Physical and Mechanical Properties of Ceramics is by far the longest chapter. The first twenty pages are devoted to phase diagrams which show phase equilibria for twenty or more different ceramic compounds. Numerous isothermal diagrams are also shown. A lengthy discussion of chemical reactions follows, which in common with other parts of the text requires a fair amount of prior learning. Special Issues, section 3.4, includes superplasticity, superconductivity, electron pairs and super particles – all topics which may surprise the casual reader.

Some idea of the level at which the authors are working can be gained by reading almost any page within Chapters 2, 3 and 5. Highlights include: Ginzburg-Landau (GL) page 280, Bardeen, Cooper and Schrieffer (BCS) Hamiltonian page 316, Generalised Einstein Field Theory (GEFT) page 476.

Chapter 4 is less intense but treats a wide range of Classical and Non-Classical manufacturing options. The uninformed will learn that classical methods employ powder, mass, forming and heat, while non-classical methods include both powder-based and powder-free procedures, wet, plastic and dry variations included. Taper, slip and freeze casting, injection moulding, extruding, roll compression, dry pressing, cold and hot isostatic pressing. Vapour disposition and bio-inspired mineralisation procedures are also considered. All processes are clearly illustrated by carefully drawn figures and photos.

The authors believe the future development of advanced materials lies beyond ceramics and depends on the pursuit of unorthodox ideas: 'the material basis for an oscillatory system generating a measurable oscillatory gravitational field' and 'the material basis for a gravitational laser', are two areas deemed to be important.

Not surprisingly, Chapter 5 is almost entirely mathematical and although it builds on theories previously explained may well lie beyond the comprehension of many. For this reason other books in the series may be more appropriate. Related titles include: *Ceramic Science and Technology*, Volumes 1 and 2; *Ceramic Matrix Composites; Mechanical Properties of Ceramics; Ceramic Materials* – all published between 2007 and 2010.

The authors, for their part, express their regret 'that it was not possible to include all works that were done at the PML … but hope that most readers consider the selection of works presented in this book satisfactory'. Their aim being to encourage others to engage in the development of new and highly sophisticated advanced materials. To this end 194 references are provided. A bonus for those who value books lies in its aesthetic appeal. The publishers have done the authors proud.

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Structural Analysis: with Applications to Aerospace Structures

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Springer-Verlag, Tiergartenstrasse 17, D-69121 Heidelberg, Germany. 2009. 943pp. Illustrated. £62.99. ISBN 978-90-481-2515-9.

This textbook is based on courses given by both authors at Georgia Tech and is aimed directly at the early years undergraduates. It succeeds admirably in meeting the students' needs by including a plethora of set problems and worked examples.

The scope of the text is very classical and can be judged simply by listing the headings of the chapters, thus. Basic equations linear elasticity; constitutive behaviour of materials'; linear elasticity solutions; beam bending in 2D and 3D; torsion of solid circular tubes and thin-walled sections; shear in thin-walled beams; virtual work and energy methods; elasto-plasticity and thermal stresses; buckling of beams and plates. The depth of the discussions and the number of examples can be judged by the fact that all of the above takes nearly one thousand pages!

These topics can be found in numerous engineering teaching texts and the applications to aerospace structures are really confined to the analysis of closed and multi-celled tubes plus the inclusion of laminated composites in the various section properties. About two-thirds of the book just analyses beams and frames.

The authors explain in great detail the theory and applications of virtual work and their equivalence in the two extremum energy principles. This reviewer has to admit to preferring just the principles of virtual displacements and forces, since we then avoid entirely the use of the calculus of variations. Moreover the way is then open in later years to general weighted residual formulations and applications to nonlinear and non-self-adjoint problems which are powerful tools in modern numerical codes.

Two minor aeronautical criticisms. Firstly in the section on material properties the two cases presented are ductile metals with a definite yield stress and a perfectly linear brittle material. No mention is made of the ubiquitous light aluminium alloys which have no definite elastic limit and need a percentage proof stress chosen to