BOOK REVIEWS

Ceramic Hardness

Reviewed by George D. Quinn, Ceramics Division, NIST, Gaithersburg, MD 20899.

REFERENCE: McColm, I. J., *Ceramic Hardness*, Plenum Press, New York, 1990, 324 pp.

This book was written with the aim of increasing the awareness of materials scientists, metallurgists, and engineers of recent developments in hardness testing of modern ceramics. Hardness is not a unique property, but is a response of the material to a specific indentor and test conditions. Several models of hardness are presented including simplified elastic or elastic plastic models, which set bounds upon the hardness limits. The sensitivity of hardness to crystallographic influences is well covered. The book covers the common test methods such as Mohs, Rockwell, Vickers, and Knoop, as well as less well known methods such as Berkovich and scratch hardness. Substantial progress has been made in recent years in utilization of microindentation methods to study fracture toughness, residual stress surface layers, and wear processes in ceramics.

The book is well structured and is a valuable contribution as a review of the state of the art, but there are some disappointments. The figures showing the Knoop and Vicker diamond indenters do not clearly define the facet angles. The author points out that hardnesses are very sensitive to test conditions, most notably microstructure, indentation size, and load. It is puzzling therefore that the extensive tables in the last chapter of the book fail to give the indentation load and further neglect to cite the original references to permit verification. The hardness precisions given are not plausible either. It is unfortunate that this book was written just before the completion of a comprehensive round-robin conducted by the National Physical Laboratory in the United Kingdom under the auspicies of VAMAS. That study highlighted serious experimental test methodology problems such as instrument calibration or operator bias which caused experimental errors of 10 to 20%.

Cracking associated with microindentations is usually to be avoided, since it interferes with the stress state under the indenter and affects the measurement accuracy. Recent developments have capitalized on the cracking, however, and a series of semi-empirical relationships have been derived which show that the extent of cracking can be used to measure fracture toughness. Unfortunately, although these relationships have some similarities, there are sufficient differences to cause a variation of over a factor of 2 in the values of fracture toughness. Rather than assess which of these equations is most suitable, McColm regrettably lists them all, thereby further confusing the reader. A variation on this methodology is to use the microindentation to produce intentionally controlled defects in test specimens. This is covered by McColm, but unfortunately Fig. 5.15 shows the wrong alignment for doing this.

Although the book is richly illustrated, it sorely misses photomicrographs of indentation damage zones and microcracking under an indenter such as those published by Hagan and Swain (*J. Phys. D.*, 1978, p. 2091) for glass.

The section on silicon nitride and silicon carbide is somewhat dated, since hot-isostatically pressed and pressureless sintered forms have largely supplanted hot-pressed and reaction bonded forms.

This book is valuable to materials scientists in part due to its excellent coverage of hardness-microstructure issues. Engineers would have appreciated more detail on test procedures, accuracy, and precision, and better tables of data. Indeed, the VAMAS round-robin conclusions cautioned strongly against using hardness as a material specification for advanced ceramics due to difficulties in obtaining consistent results.

Engineering Project Management

Reviewed by Everett C. Shuman, Registered Professional Engineer, State College, PA 16801.

REFERENCE: Blanchard, F. L., *Engineering Project Management*, Arabian American Oil Company, Dhahran, Saudi Arabia; Marcel Dekker, New York, 1989.

Engineering Project Management is part of a series on Cost Engineering. While the book is relatively short, 246 pages, the author has presented a wide range of details on many typical projects that are worthy of study by persons in managerial positions or who are inspired to become an effective manager. In a Preface, Blanchard gives reasons for the principles that are presented, but points out that there are so many ramifications in each project that answers to questions cannot be given like "recipes in a cookbook". Many terms are defined, including *project*.

A major item, although brief, is his Apology to all women because, when he wrote the book, he referred to managers only as men (e.g., in the chapter on selecting the project manager is a section on Picking the Man.

Each of the seven chapters starts with a Prologue that gives perspectives for the reader to consider and ends with a conclusion with a list of references. There are also footnote references when they apply to the text.

Many diagrams illustrate the interactions of the factors involved. Flow diagrams are used to indicate sequences in critical paths, construction timing to avoid delays, or engineering discipline in equipment design.

While Blanchard's experience has been many years in large corporate operations, he points out that the basic principles apply to any size project, no matter how small. Yet he also writes a chapter on megaprojects, those costing over 100 million and into the billions of dollars.

