Gmelin Handbook of Inorganic and Organometallic Chemistry: Silicon
Frederich Schroder, Series Editor
(Springer-Verlag, 1991, 1994, 1995, 1996)
ISBN 3-540-93630-0 (vol. B. 5C)
ISBN 3-540-93716-1 (vol. B. 5d2)
ISBN 3-540-93733-1 (vol. B. 5b1)

The five volumes considered here are comprehensive reviews of the published literature on silicon nitride retrieved by computer search of the Chemical Abstracts database. The subtitles of the volumes indicate their broad scope: *Supplement B. 5C, Silicon Nitride in Microelectronics and Solar Cells* (1991); *Supplement B. 5e, Non-Electronic Applications of Silicon Nitride. SiN_x, SiN_x:H* (1994) (reviewed in *MRS Bulletin*, March 1995, p. 72); *Supplement B. 5dl, Silicon Nitride: Electrochemical Behavior, Colloidal Chemistry and Chemical Reactions* (1995) (reviewed in *MRS Bulletin*, February 1996, p. 86); *Supplement B. 5d2, Silicon Nitride: Chemical Reactions* (continued) (1995); and *Supplement B. 5bl, Silicon Nitride: Mechanical and Thermal Properties; Diffusion* (1996). All of the volumes follow a similar format; they are divided into subtopic chapters reflecting the overall theme of the volume. The series editor is Frederich Schroder. Two of the volumes were written by a single author, whereas the others had as many as four authors for the different sections.

These books are useful as reference works for those desiring to learn what is known about silicon nitride and what are the primary sources for that information. The discussion is brief and to the point with the primary aim to give a comprehensive rather than in-depth discussion of any particular topic. Thus, in the aggregate these five volumes cite over 12,000 references to the worldwide technical and patent literature in 1,750 pages of text. The cut-off dates for the literature reviews are generally about two years before the listed publication dates. Those literature results are generally taken at face value and little attempt is made to resolve contradictions between different publications. The philosophy seems to be to get it in print so as to provide the reader with a guide to the original sources if further detail is needed.

Volume B. 5C, Silicon Nitride in Microelectronics, will be of interest primarily to those involved in semiconductor processing. The silicon nitride discussed here is in the form of thin films, frequently amorphous and nonstoichiometric, made by various vapor phase techniques. A partial list of topics includes preparation, patterning, passivation layers, masks, contacts, interconnects, and isolation layers. A number of chapters discuss the literature on use of silicon-nitride films in devices such as field-effect transistors (FETs), metal/nitride/oxide/semiconductor (MNOS) memories, charge-coupled devices (CCDs), random access memories (RAMs), and FET-integrated circuits. The book makes effective use of illustrations and it has a very good subject index and table of acronyms.

Volume B. 5d2, Silicon Nitride: Reactions, along with the first of this two-volume set *(B. 5dl)* presents a comprehensive, coherent discussion of what is known about reactions of bulk silicon nitride and multiphase ceramics that contain silicon nitride. The presentation summarizes the literature on thermodynamics and kinetics of reactions and phase relations of the resulting products. The organization is logical, beginning with reactions with solids (metals, metal nitrides, and metal oxides, each arranged by periodic group), followed by reactions between silicon nitride with gases (air, oxygen, water vapor, halogens), and finally discussing miscellaneous reactions with other inorganic compounds, salts, acids, and organo-metallics. An exceptionally good index of reactants as well as over 100 figures and many tables make the set easy to use as a reference. The last chapter is a short but effective summary of the literature on the biochemistry and toxicity of silicon nitride that every worker in the field should read.

Volume B. 5bl, Silicon Nitride: Mechanical and Thermal Properties; Diffusion, covers physical and mechanical properties of silicon nitride including density, modulus, hardness, wear, and friction. About two-thirds of the volume is devoted to review of the literature on silicon nitride strength, fracture toughness, fatigue behavior, thermal shock resistance, and failure analysis at ambient and elevated temperatures. Short sections cover the strength of silicon nitride joints, thermal and thermodynamic properties of silicon nitride, and diffusion in silicon nitride. Because the effective closing date for this volume was December 1992, much of the latest information on silicon nitride is not included. In particular microstructure-dependent properties such as strength and fracture toughness are substantially better in present-day silicon nitride (e.g., AlliedSignal's AS 800) than the materials described. Readers wanting to learn about properties typical of materials that are currently being applied commercially will have to look elsewhere, such as in M. Hoffman and G. Petzow, eds., *Tailoring of Mechanical Properties of Si_3N_4 Ceramics*, (Kluwer, Norwalk, MA 1994).

The primary value of this series is in its comprehensive review of the technical literature on silicon nitride. It is useful in patent searches, bibliographies for research proposals, and for overviews of the literature on unfamiliar topics. The volumes would not be so useful as textbooks or as an introduction for someone unfamiliar with the field.

Reviewer: *Ronald E. Loehman is Manager of the Advanced Materials Laboratory at Sandia National Laboratories and National Laboratories Distinguished Professor at the University of New Mexico in Albuquerque, NM. His research is in the areas of ceramic-metal reactions, ceramic joining, and ceramic composites. He is a Fellow of the American Ceramic Society and Associate Editor of the* Journal of the American Ceramic Society.