The book will be a valuable resource for everyone interested in advanced ceramic materials.

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Silicon Nitride: Mechanical and Thermal Properties; Diffusion. By Roger Morell and Frank L. Riley. Silicon Supplement Volume B 5bl. Gmelin Handbook of Inorganic and Organometallic Chemistry: 8th Edition. Edited by Friedrich Schröder and Wolfgang Kurtz. Springer–Verlag, Berlin, 1996. ISBN 3 540 93733 1. DM 2500.

Silicon nitride ceramics are one of the most interesting structural materials for replacing metal compounds in high-temperature applications in engines and gas turbines, but they may also be useful for many applications where a high wear resistance is required. The increasing interest in using silicon nitride ceramics as turbocharger rotors, valves, bearings or cutting tools is due to the enormous progress made in recent years in developing high strength materials with high reliability, and excellent thermal shock resistance. These world-wide research activities have produced thus far more than 34 000 publications on silicon nitride and the number is growing at a rate of 2000 to 3000 per year. Therefore, it will be difficult for most researchers to get a quick overview of the available data.

The Gmelin Institute for Inorganic Chemistry, known for its careful and extensive literature search, has summarised the most important information on silicon nitride. Between 1991 and 1995, the Gmelin Institute published four Silicon Supplement Volumes on silicon nitride. The last Supplement Volume B 5b1, dealing with the mechanical and thermal properties as well as the diffusion, has just been released. It is based on the available literature up to December 1992, but also on some proceedings published later. The book totals 415 pages and is divided into nine main sections under the following headings: density, elastic properties, hardness and wear resistance, strength and related properties, plastic deformation, thermal stress and thermal shock resistance, mechanical properties of silicon nitride joints, thermal properties, and diffusion in silicon nitride. Several of these chapters begin with an overview or general remarks, so that also non-experts are able to understand the succeeding results. Each chapter is clearly organized, and the three main types of silicon nitride ceramics, reaction bonded Si_3N_4 (RBSN), sintered Si_3N_4 (SSN), and hot-pressed or hot isostatically pressed Si_3N_4 (HPSN, HIPSN), are discussed separately; basic mechanical properties of CVD-Si_3N_4 are also given.

The first part of the Handbook presents basic physical and thermomechanical data of the various silicon nitride materials, followed by an overview of hardness and wear resistance measurements; the thermal properties are covered in a separate chapter. These basic data on Si_3N_4 ceramics are a very helpful guide for engineers who design silicon nitride components. The chapter 'Wear and Friction Properties' is relatively short compared to others, although these properties are important for many applications. The main topic, 'Strength and Related Properties', covers 212 pages and describes in detail the short-term and long-term behaviour of silicon nitride ceramics. It considers the influence of additives, processing conditions as well as the microstructure on the mechanical properties, but also discusses strategies for improving the strength and fracture toughness. However, since most of the literature is older than 5 years, most of the recently published and fundamental results concerning the influence of the grain boundary chemistry and the effect of grain size and morphology on toughness and strength are not included. These aspects are expected to be included in a forthcoming Gmelin Handbook article on the microstructure. Additional information is given on the effect of environmental conditions on the degradation of the mechanical properties. Also covered are fractography, non-destructive flaw detection, and the reliability of silicon nitride products. The analysis of the thermal stress and thermal shock resistance not only covers Si_3N_4 bulk ceramics, but also thin films and coatings. The section on joints contains very useful results of the different methods to realize joints between Si_3N_4 and other materials. Measurements of the self diffusion and the heterodiffusion of hydrogen, metals, and non-metals are presented at the end of the book.

The authors, Roger Morell and Frank L. Riley, both well known in the ceramic community, and Joachim Wagner of the Gmelin Institute have done a great job in extracting the important data on the mechanical properties from a huge number of publications. There is no doubt that this volume provides the best available summary of the last three decades of silicon nitride research. Many scientists and engineers, especially those who start to work with Si_3N_4 ceramics can save a lot of time by using this well-prepared Handbook volume. Therefore, technical libraries should be encouraged to buy this volume despite the relatively high price of DM 2500.

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