

INTRODUCTION

In the last 5 years, boron nitride (BN) films became more available. Renewed interest in this material has yielded new preparation methods and applications. A wide variety of synthesis methods are now being used and boron nitride films can be grown in many phases. The cubic phase, the most desirable phase for applications, is still hard to grow. A large number of applications will benefit from BN films. In particular, three main areas show the biggest immediate promise: thin membranes for x-ray masks, electronic applications for high temperature active devices and insulators, and friction reducing coatings. The low atomic number combined with mechanical strength give BN the edge for the x-ray masks, while the feasibility to dope the semiconducting cubic BN with both n and p type impurities makes BN a strong competitor to diamond-based electronics. It is safe to state that BN is competing with diamond and silicon carbide (SiC) in most applications. Therefore, most of the Materials Research Society and other meetings that included BN were part of a diamond and SiC symposium. Each proceedings volume includes a small number of short papers. There is no single book describing in detail the most important work done in the last several years in the field of BN films. In order to fill this gap, Dr. Fred Wohlbier (Trans Tech Publications) invited us to edit this book.

There are two main purposes to this book: first, to give a scientist starting in this field a way to know, in detail, the state-of-the-art; second, to give researchers already in the field a timely and more complete description of work done in laboratories all over the world, without looking for original publications. Most chapters contain original results that have not yet been published elsewhere. In addition, the book can serve as a reference book for people not working in the area.

The book is divided into three sections: synthesis, properties and applications. All the chapters in the book are invited chapters. Each section contains 5-7 chapters. Most of the chapters summarize the work that has been done over several years. In many cases, a chapter could easily be classified under more than one section. Each chapter contains synthesis, and/or properties and/or applications. Therefore, in these cases, the classification of the chapters may look somewhat arbitrary.

The first section is devoted to synthesis. This is a very important issue, as BN film growth is not a trivial endeavor. In the first chapter, Professor Aita is reviewing the sputtering method for BN deposition. Sputtering and ion beam methods are described in the second chapter (Guzman and Elena), while other modifications of the ion beam deposition technique are discussed by Fujimoto and by Halverson et al. in chapters 3 and 4 respectively. Chemical vapor deposition (CVD) methods are described in chapters 5 (Nakamura) and 6 (Sugiyama and Itoh). The pulsed laser evaporation method is described in the last chapter (Murray) of this section. Most chapters also give characterization results, some of them in great detail.

The section on properties starts with a theoretical paper (Lam et al.) devoted to the electronic and structural properties of several BN phases, while the next chapter (McKenzie et al.) reviews the work done analyzing the structure of BN films. A study of Auger transitions in the BN system is reported in the next chapter (Hanke et al.). The subsequent two chapters (Dana and Karnezos) describe the low pressure CVD process used to grow thin BN films for x-ray lithography masks. A wide variety of characterization methods are covered. Stress, dielectric properties and radiation effects are also described. The following two chapters (Osaka et al., Montasser et al.) focus on films made by plasma CVD. Results on the mechanical and optical properties are presented. As mentioned above, four chapters in this section also describe preparation methods, while some include applications.

The last section is devoted to applications. Growth and application of single crystal cubic BN, with both p and n doping, are described by Mishima. Although this achievement was done using crystal growth technology, we incorporated it in the book to show that this important application is within reach using cubic BN. Applications of BN films as a gate dielectric in field effect transistors are described in the next two chapters (Yamaguchi and Kapoor). The last two chapters of the book (Miyoshi and Kuwano) describe the applications of BN films in tribology for friction-reducing coatings. Similar to the other sections, several chapters in this section contain synthesis and characterization. Most notably, the chapter by Yamaguchi contains a theoretical study of the electronic structure of BN.

The book does not cover all the work and all the groups in the field of BN films. There is a limit to both the scope of this book and the ability to collect up-to-date material. However, we believe that we covered the most important aspects of preparation, characterization and applications.

The invited chapters are of high scientific quality and up-to-date results are presented. We believe that the book will be used extensively by researchers already in the field, newcomers and researchers that need a general reference to this new and developing area.

We would like to thank all authors for their contributions, without which this book could not be published.

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