Preface

The trend in the development of digital and optoelectronic devices has been toward higher speed and smaller size, driven by the need for more powerful processors, computing systems, and communications systems. The formation of these smaller, more aggressive structures has been facilitated by improvements in our ability to fabricate and process materials. In many cases, new classes of devices, such as the modulation-doped field-effect transistor and solid-state lasers based on heterostructures, have resulted from the invention of new material-synthesis techniques. Some examples of these new devices were recently described in the July 1990 issue of this journal. Several papers in the present issue discuss some of the advances in materials which have made these devices possible.

The size reduction of most electronic device structures requires the use of thin-film deposition and processing techniques. The composite layers of an electronic device structure can range from semiconductors to metals and insulators. The primary focus has often been on the deposition of semiconducting materials which form the active region of the device structure. The primary semiconductor systems in current use are the Si- and GaAs-based materials. Chemical vapor deposition (CVD) is a key technology for the formation of transistor structures and, more recently, metallic interconnections as well. This gas-phase chemical process advances through progress in associated growth chemistry and reactor design.

Novel CVD chemical systems and new applications of CVD to the formation of Si and Si–Ge alloys and the whole range of III–V semiconductors are discussed in the first four papers of this issue. The addition of a plasma to the CVD growth environment has led to the controlled deposition of thin layers of diamondlike carbon films. These hard, transparent, and chemically resistant thin films are potentially useful as protective coatings.

Smaller device structures have resulted in higher levels of circuit density incorporating smaller, more numerous device interconnections. Such microscopic "wires" are essential to the formation of the integrated circuit. New materials and three-dimensional wiring schemes are at the forefront of packaging and integrated circuit research. This field is reviewed with a perspective on the implications for VLSI circuit development. Metallic interconnections between devices are formed by the deposition of metals or, in some cases, the solid-state formation of high-conductivity intermetallic compounds. Surface science tools and techniques are being used to understand the physics and chemistry of such layer formation, as illustrated in the two papers on tungsten and silicide deposition.

Central to a computing system is the availability of mass data storage. Magnetic data storage has also benefited from the use of new materials and deposition techniques. Thin-film techniques, once primarily applied to the formation of semiconductor devices, are being used in the generation of new magnetic recording and retrieval systems. Thin multilayer magnetic structures may find application in recording media and recording heads. Two contributions to this issue highlight the advances in and importance of the continued development of the thin-film processes used in the magnetic data storage arena.

The final contribution to this issue deals with the use of new substrate materials for the formation of the high-critical-temperature superconducting layers. Use of these exciting materials in many electronic applications will rely on the ability to form small thin-film structures, compatible with and analogous to those of the existing semiconductor technology.

New materials and the novel structures generated by the development of advanced processing techniques will continue to facilitate the development of electronic device technology in the coming years. The papers in this issue represent a small sample of work underway in this important field.

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