# Introduction

This special technical publication is organized into six sections: (1) Crystal Growth and Epitaxial Deposition Techniques; (2) Fabrication Technology; (3) Microcontamination; (4) Metallization and Interconnects; (5) Material Defects and Gettering; and (6) Control Charts, Standards and specifications. The papers describe technology and metrology of these areas. The brief synopses on two workshops; (1) Gettering Techniques and Characterization; (2) Gallium Arsenide are presented in the Appendix.

## CRYSTAL GROWTH AND EPITAXIAL DEPOSITION TECHNIQUES

Most of the monocrystalline silicon is manufactured by Czochralski method, the paper by Yamashita et al describes the effect of magnetic field on the segregation coefficient of dopant and on oxygen content during crystal growth. Robinson and Lawrence in their paper present the characteristics of a high rate single wafer novel epitaxial reactor. The properties and preparation of silicon are discussed in few papers and the metrology and surface quality in others in this section.

## FABRICATION TECHNOLOGY

Ion implantation, CVD, polysilicon and plasma processing are discussed in depth in this section. One of the papers on dry etching presents reaction mechanisms and process to etch silicon dioxide. While process needs to be precise, controlled and accurate, every paper in this section describes the importance of metrology associated with the process. The paper by Ygartua and Swaroop provides information on the formation of defect-free buried layers using ion implantation. Subrahmanyan et al discuss ways to improve the accuracy of the junction-depth measurements. The paper by Starov and Lane gives a technique to improve poly-Si uniformity. Other papers in this section are on the processing and metrology issues related to dry etching.

## MICROCONTAMINATION

Particle contamination is an important issue in semiconductor processing. It covers a wide area from the gases, chemicals and materials used in processing to the environment where fabrication takes place. The three papers in this section discuss particle standards, particle counters, and ways to reduce particles in process fluids.

## METALLIZATION AND INTERCONNECTS

The strategies for the yield enhancement due to improvement in metallization and interconnects are described in this section. Discussed are various items such as, the film specularity of the sputtered aluminum, and double level metallization processes. The paper by Kuo describes major issues in an isolation process. He discusses oxide isolation, selective epitaxy for trench isolation, and silicon-on-insulator technologies.

## MATERIAL DEFECTS AND GETTERING

This section covers a wide area relating to oxygen precipitates, metallic impurities and process-releted defects. The gettering of defects and impurities during device fabrication provides better devices. This is exactly what is stressed in many papers in this section. The first four papers are on the detection and reduction of metallic impurities, and the measurement of minority carrier lifetime in semiconductor material.

Intrinsic and extrinsic gettering are widely employed in semiconductor processing for the reduction of material and in-process defects and contaminants. Various techniques, such as, the use of oxygen precipitates, poly on the backside of wafers, epitaxial encapsulation and the use of epitaxial misfit dislocations are described to provide intrinsic and extrinsic gettering. The paper by Goldstein and Makovsky describes the SIMS technique to measure oxygen content in semiconductor material.

CONTROL CHARTS, STANDARDS AND SPECIFICATIONS

And finally, the most important section in this publication is on Control Charts, Standards and Specifications. Four papers are presented. The paper by Friedman is on the use of on-line statistical process control for IC fabrication. Different ways to analyze production data are discussed. The paper by Keller et al describes the use of statistical techniques to test equipment and tool capability. The paper by Lowry discusses the impact on production and material quality programs brought about by the introduction of statistical process control in microelectronics manufacturing. It emphasizes the need to understand process capability and to employ statistical quality control limits rather than engineering spec limits. And the fourth paper in this section is on the Economic Impact of Standards on Productivity, once again stressing the need of Standards in semiconductor industry.

Dinesh C. Gupta
Editor.