

TABLE 2
Titles of Final Projects in Fall 1985, 1986

- Molecular Beam Epitaxy
- Silicon on Insulators: A Focus on Epitaxial Lateral Overgrowth
- Solid Phase Epitaxy of Silicon
- Gettering
- GaAs Contacts: Theory and Practice
- Review of the Thermal Nitridation of Silicon
- A Comprehensive Study of Plasma Etching Technology
- Optical Resist Systems
- X-Ray Lithography: The Solution to Submicron Device Design?
- Resist Material Considerations for VLSI Edge Definition in Lithography
- Kinetics in the Vapor Phase Epitaxy of GaAs
- Alternatives at the UV Limit of Optical Lithography
- Recent Studies on the Kinetics of Epitaxial Silicon Growth
- X-Ray Lithography
- Metalorganic Chemical Vapor Deposition
- Low Pressure Chemical Vapor Deposition Reactors
- Chemical Vapor Deposition of II-VI Materials
- Low Temperature Deposition of Silicon Dioxide

cussed briefly, either because chemical engineers are already familiar with some of the basic principles of these processes (e.g., oxidation, diffusion) or because many aspects of such processes have been previously covered (e.g., metallization). Also, diagnostic techniques and device and circuit fabrication are briefly discussed. Some emphasis is given to isolation, self-alignment, local oxidation, planarization, and gettering.

The last stage of this course is a final project that is mandatory for all graduate students (and optional for all undergraduates) who take the course. After choosing from a list of topics, each student works on his/her own project. Topics covered in the past two years are listed in Table 2. Within such a project, a student is expected to critically review any existing literature and to present his/her own (perhaps innovative) ideas for improving or developing various processes.

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ChE book reviews

COMPUTER-AIDED ENGINEERING FOR INJECTION MOLDING

Edited by Ernest C. Bernhardt

MacMillan Publishing, New York 10022, 1984

Reviewed by

Donald G. Baird

Virginia Polytechnic Institute

This book is a collection of topics involving the application of computers to the design and control of the injection molding process. Unfortunately, as noted by the editor, the chapters lack coordination and hence the book represents a collection of topics rather than a unified text. However, it is one of the first attempts in the polymer field to develop a complete package starting with the ideas of hardware, process control techniques, the basic equations which are required to simulate injection molding, and the application of computer simulation to solving injection molding problems.

The book is divided into three sections, with the first section being entitled "State of the Technology." The first chapter in this section is rather general in nature and attempts to explain in qualitative terms how the computer is used in the design of injection molds. For example, it is illustrated how a mold designer might use a computer simulation to predict where weld-lines would lie and how the location of cooling channels would change the temperature distribution in a part. Certainly this information is useful, but it does not allow one to accomplish any quantitative design work. The second chapter is also quite qualitative in nature as it describes melt flow in

cavities. This chapter does emphasize the importance of fountain flow to the development of properties and the fact that the properties of a part are related to melt flow. However, there are a number of topics, such as computer hardware and computer languages, which seem to be unconnected to the first part of the discussion and of such elementary level that they serve no practical purpose. For example, the distinction between mainframe computers and minicomputers doesn't seem to be necessary. The third chapter is also of limited value as it attempts to explain how the mold designer might use computer aided design (CAD) but it never specifies what packages are available or gives examples as to how the mold designer could use CAD. Hence, in general, the first three chapters are so descriptive in nature that they serve very little practical purpose.

Following these first three qualitative chapters comes Chapter Four, which presents some of the basic equations which are required in the modeling of injection molding. Although this information is well presented and lends to the understanding of what equations must be solved, there is no connection between this chapter and the rest of the book. Furthermore, the author of the chapter does not explain how these equations are solved on the computer nor how they could be used in computer aided design. Finally, the material reflects mostly the author's view of simulating injection mold filling, and fountain flow is neglected.

Chapter Five is descriptive again and describes how the computer is used in process control. Control is all based on reading some process variable such as mold pressure which must be within some specified range based on previous experience in generating parts with acceptable physical properties. This approach relies on no real knowledge of the mold filling process. The failure to point out the limits of such an approach would be quite beneficial, but this is not done in the chapter.

Chapters six through eleven constitute Part II of the book, which is entitled "Applications." Again, the chapters are not connected nor do they always fit within this heading. Chapter Six discusses how a part is designed through structural analysis, but there is no direct correlation back to mold design. The next chapter discusses (only in a very qualitative sense) mold design. Only one particular CAD/CAM system is described. Chapter Eight is how an integrated approach for the design of an injection molded part should be implemented. Again, the chapter is very descriptive and one has no idea as to the limitations of the approach used by the authors.

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Chemical Engineering faculty position: A tenure track position is available for August, 1988, at the University of Florida. The rank and area are open. Applicants should submit a brief resume, a description of research objectives, and the names of three references to: Dr. H. H. Lee, Chairman of Search Committee, Department of Chemical Engineering, University of Florida, Gainesville, FL 32611. The University of Florida is an Equal Opportunity/Affirmative Action employer.

In Chapter Nine, the Mold Flow program and its application to solving molding problems are discussed. This chapter is quite well done and does demonstrate how a simulation can be used to solve molding problems. Again, however, the limits of this program and the range of problems it can handle are not discussed. This chapter should have been placed near Chapter Four. Chapter Ten, which is concerned with mold cooling, is also well-written, but should be grouped with Chapter Four.

The last chapter in section II is concerned with data acquisition and control of the injection molding process. This chapter is of educational value as it ex-

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plains the methodology of process control. This chapter bears some similarity to Chapter Three, but is much more thorough and useful.

The last section (Part III) is concerned with data bases and contains Chapter Twelve. It is one of the more useful chapters in the book as it describes the importance to the designer of having data banks available containing the physical properties in both the solid and molten phases of each thermoplastic. This data should be readily available in both the part design and process simulation phases and must be stored in the computer system. The chapter contains an overview of the development of the present data bases, including the types of data available in present systems and future trends.

In summary, there are a number of useful chapters in the book, but unfortunately the connection between chapters is not readily apparent. For the inexperienced engineer, it would be difficult to assemble the appropriate knowledge from this book and then apply it to process control or mold design. The book would be more useful if a section on principles of injection molding, including the fluid mechanics of mold filling and its connection to the properties of a part, were included at the beginning of the book. □

TRANSPORT PHENOMENA

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pleted these courses they will know what to look for when they encounter new problems, and they will have acquired the tools necessary to solve a great many of them.

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MICROGRAVITY

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gineers to develop entirely new processes, to understand current unit operations more thoroughly, or to adapt earth-based unit operations for the demanding environment of space.

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