

Scheduling of Diffusion Furnace in Semiconductor Manufacturing - A Literature Review, Classification and Simple Meta-Analysis

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Abstract

Scheduling began to be taken seriously in manufacturing industry at the beginning of 20th century with the work of Henry Gantt and other pioneers. Manufacturing industries have to meet shipping dates that have been committed to customers, as failure to do so may result in a significant loss of goodwill. Hence, they have to schedule the activities in such a way as to use the resources available in an efficient manner. Among various manufacturing industries, semiconductor manufacturing industry is an extensive and highly competitive industry mainly due to the fact that both price and product-life for new electronics products are decreasing exponentially over time along with rapid technological advancements. In such kind of industries, the capability of meeting due-date along with the reduction of cycle time is the most decisive factor of the fierce competition in the global market place. Hence, scheduling research remains among the most important tasks that must be performed routinely in SM industry.

Further, among various stages of SM, wafer fabrications are the most technologically complex process and challenging industrial environments in use today. The diffusion operation, carried out on batch processing machine, heavily impacts the production rate of wafer fabrication and in turn the SM industry. This is due to the fact that, diffusion operation requires relatively longest processing time among all the operations in the wafer fabrication. Hence, there is a rich amount of research studies available in scheduling of diffusion furnace (DF) since 1991 (i) to improve the due-date compliance, (ii) for significant reduction in the overall production time due to their longer processing time compared to other operations in the SM, and (iii) to effectively utilize the expensive resource. At the same time, the new researchers are struggle hard to get the relevant research studies. Therefore, it is essential to harness the available research studies.

Accordingly, this study presents a literature review, classification schemes and a simple meta-analysis for scheduling of DF research in SM industry. This review is based on a study of journals and web based documents/articles, which include conference materials, lecture notes in computer science, working papers, etc., which has been published between 1991 and 2019. Based on the detailed literature review carried out, this study grouped the existing literature based on (i) type of data, (ii) machine environment, (iii) nature of scheduling, (iv) objectives, and (v) methodology considered by the author. This study help the researchers (readers), who are interested in scheduling of DF by providing the source of reference, to identify the gap/untouched research problems and to understand the trend in scheduling of DF.

Keywords

Semiconductor Manufacturing, Diffusion Furnace, Literature Review, Classification Schemes, Meta-analysis.

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Biographies

Dr. M. Mathirajan obtained his Ph.D. in Operations Management and M.S. (engineering) degree by research in Applied Operations Research from Indian Institute of Science (IISc), Bangalore. He also received M.Sc. degree in Mathematics from Madurai Kamaraj University and Postgraduate Diploma in Operations Research from College of Engineering, Guindy, He has been working as faculty of IISc Bangalore since 1986 and is serving as a Chief Research Scientist since the year 2013. His areas of interest include Mathematical/Heuristic Optimization and Research Methods for Operations and Supply Chain Management, Sequencing and Scheduling, Personnel Scheduling, Routing and Scheduling of Logistics, Urban Road Transport, and Container Terminal Logistics problems. His Ph.D. thesis was adjudged the Best thesis and was awarded the prestigious M.N. Gopalan Award of 2002 at the annual convention of the ORSI. He has more than 50 publications in journals of international and national repute. He has published two books and five edited books/proceedings as co-authors. He is a recipient of Singapore-MIT Alliance (SMA) Research Fellowship of Nanyang Technological University (NTU), Singapore. He has been a Visiting Professor at NTU, Singapore and Sultan Qaboos University, Oman-Muscat.

Dr. M. Vimala Rani is an Assistant Professor, at VGSOM, IIT Kharagpur. She obtained her Ph.D. degree in Operations Management from IISc, Bangalore. In 2019, her PhD thesis was adjudged as the Best Ph.D. thesis in the Department of Management Studies (DoMS), IISc. After her PhD, she has worked as “IISc Research Associate” at DoMS, IISc. She also worked as Assistant Professor at Amrita School of Business, Bangalore. Her research interest is on developing the mathematical and heuristic algorithms for the problems related to Industrial Engineering and Management.