

TEHER ALATT NÖ A PÁLMA (Hungarian proverb)
Die Palme wächst unter dem Gewicht (Deutsche Übersetzung)
Palm-trees grow under burden (English translation)

Wilfried Lerch^{1,a} and Juergen Niess^{1,b}

¹ Mattson Thermal Products GmbH, Daimlerstrasse 10, D-89160 Dornstadt, Germany

^a wilfried.lerch@mattson.com, ^b juergen.niess@mattson.com

With this special issue entitled “*Rapid Thermal Processing and beyond: - Applications in Semiconductor Processing*” we are pleased to present selected contributions from invited semiconductor technologists all over the world. This edition of the periodical “Materials Science Forum” contains 30 contributions from authors from nine different countries around the world. The book is arranged in sections focussing on the various aspects of Rapid Thermal and Millisecond Annealing and is arranged to follow the major process flow steps in high performance transistor fabrication, without claiming to be a complete collection of all Rapid Thermal Processing (RTP) steps in use today.

Starting with the silicon wafer material itself and emphasizing various aspects of the device from advanced gate dielectrics through to source/drain engineering, this issue ends with a summary on fully silicided gates. Furthermore the thermal processing system development over the past 30 years is highlighted for full-wafer millisecond annealing, laser annealing and the high volume production RTP systems. Also the latest insights in surface cleaning for nano-technology as well as Secondary Ion Mass Spectrometry are discussed.

Rapid Thermal Processing (RTP) technology has evolved from a rather primitive status about 30 years ago to become a mature application in semiconductor manufacturing today. It was difficult to use the early equipment to provide uniform and repeatable heating and the technology was originally only introduced into production in applications that allowed for very large process control windows.

If not supported and pushed ahead by a few scientists and engineers, the technology would probably have disappeared a few years later again. But those developers were enthusiastic for the potential of this novel heating method and were persistent enough to find work-arounds and solutions for all the problems that emerged over the years.

One of these scientists, driving RTP to its current performance, was a Hungarian Chemist, who almost by accident got engaged with a young RTP start-up company at Blaubeuren, close to Ulm in Germany – Dr. Zsolt Nényei. Since then he has been a key driver of the technological progress over the last 20 years, starting at AST Elektronik GmbH - through STEAG - up to now at Mattson Thermal Products GmbH, continuously working to provide the technology background and features requirements leading to today’s success of RTP.

Being engaged in several specific fields of RTP he provided contributions in open-loop and defect guarded processing, emissivity-independent temperature measurement, pattern effect evaluation and minimization. He revealed the flexibility of RTP systems for novel processing methods, including a new approach to thermally grow a low leakage gate dielectric of 1.6 nm and below. All these studies and other projects resulted in more than 60 publications in scientific journals and at international conferences, as well as 15 patents, including key equipment and processing concepts such as “defect guarded processing”, that have been widely exploited in production. This is especially true for the more than 1200 RTP systems produced by AST Elektronik and successors up to today. Beyond that he supported the community by editing and co-organizing the International RTP conferences as well as the German RTP Users Group Meetings, providing inputs to the German “Arbeitskreis

Heizprozesse" within the VDE/VDI - Gesellschaft Mikroelektronik, Mikro- und Feinwerktechnik (GMM) and teaching young scientists and engineers at international seminars. To achieve all this he sought the highest levels of performance from the technology and from his co-workers too. But he also enjoyed entertaining us. His Hungarian proverbs are unmatched and get to the point of a situation (see title). The drawings (usually supplied by his talented daughter) always drive home an important point, but do it with humor. His retirement in 2008 marks a transition in the history of the development of RTP technology, with one of the pioneers in commercializing RTP no more actively working in the field.

To honor his accomplishments and consequent commitment to RTP, this book was created with contributions from specialists in the field and related areas. The authors and the editors want to express their special thanks to Dr. Zsolt Nényei with this synopsis. The idea to write this book as a dedication to Dr. Nényei's lifetime work on RAPID THERMAL ANNEALING was accepted by all the authors and put into action with enthusiasm.

The editors want to express their special thanks to all the authors for their support of this project, and for submitting high-quality papers which make this special issue a success. Authors from all over the world, from most leading semiconductor and equipment companies and especially friends and colleagues of Dr. Nényei contributed to this overview on the latest Rapid Thermal and Millisecond Annealing process technology. In particular, we want to express our sincere thanks to Jeff Gelpey who helped and supported us continuously in the background.

Zsolt always was a mentor, teacher and still is a friend during our entire history of work together but especially in critical situations. He reminds us that even after several years of work on Rapid Thermal Annealing still there are hidden miracles and technology problems to be solved.

Zsolt, thank you for the time we had together, nevertheless let us proceed!

Wilfried Lerch

Juergen Niess

Dornstadt, May 2008