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Editors: J. David Cohen, John R. Abelson, Hideki Matsumura and John Robertson

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PREFACE

Researchers from around the world met to attend and present papers at Symposium A, "Amorphous and Heterogeneous Silicon-Based Films—2002," held April 2–5 at the 2002 MRS Spring Meeting in San Francisco, California. This symposium attracted over 200 participants with more than 150 scientists presenting papers during the four-day symposium. It thus continues to be one of the largest and most active symposia at the MRS Spring Meetings. This year we again were particularly pleased to see the large component of young scientists presenting their exciting new results. Indeed, three Graduate Student Awards were given to the participants of this symposium as well as one Best Poster Award.

The particular field represented by Symposium A has generated an annual series of strong symposia of the Materials Research Society which dates back to 1982. However, the scientific emphasis has changed dramatically over that time, and it continues to evolve. For example, in contrast to the MRS symposium entitled "Amorphous Silicon Technology" held 10 years ago, this year's meeting was nearly evenly divided between amorphous silicon and microcrystalline silicon. This year more than 15 papers reported on materials properties or devices deposited using the hot-wire CVD growth process (compared to none in 1992 and only a half-dozen five years ago). Also, papers dealing with the fundamentals of metastability and equilibration in amorphous silicon numbered well below ten this year, compared to nearly 30 ten years ago. This does not imply that there was a serious lack of papers trying to advance the fundamental understanding of these materials. However, it does reflect a general shift in Symposium A in recent years toward emphasizing the important technologies based upon amorphous and heterogeneous silicon (Solar Cells, TFT's, Imaging Arrays, Sensors, etc.). This year's symposium continued that trend.

The papers in Symposium A were selected from more than 170 submitted abstracts by the five symposium organizers together with five international advisors. These latter individuals were asked to help in this task because their internationally recognized areas of expertise complemented and extended those of the organizers. The advisors for this year's symposium included David E. Carlson, Peter A. Fedders, Michio Kondo, Gregory N. Parsons, and Martin Stutzmann. These advisors helped in many aspects of this year's successful scientific program, including the selection of invited speakers, ranking the submitted abstracts, chairing the sessions, and refereeing papers. The organizers wish to express their sincere gratitude and appreciation to these individuals for all of their valuable input and effort.

This year the 114 papers appearing in this proceedings have been sorted under eleven Chapter headings on the basis of subject matter. The pages are numbered serially; however, each paper has also been identified with its original program number so that it can be matched up with its position during the actual symposium.

Chapter I is concerned with basic mechanisms of growth—for both amorphous and microcrystalline silicon—and also with new approaches to film growth. This chapter is highlighted by invited papers by Richard van de Sanden (Eindhoven University of Technology) and Stacey Bent (Stanford University). There is some overlap of this chapter with Chapter II which specifically focuses on hot-wire CVD produced amorphous and microcrystalline films. However, Chapter II concentrates more on film properties rather than growth mechanisms. Areas of emphasis for this Chapter are set by invited papers by Atsushi Matsuda (Japan Advanced Institute of Science and Technology) concerning recent progress in industrial applications of the HWCVD process, and by Friedhelm Finger (Forschungszentrum Jülich) concerning the defect structure in microcrystalline silicon prepared by this process. Chapter III deals with the somewhat related subjects of film crystallization and re-crystallization. It also contains a paper on the fabrication of an ordered array of nanocrystalline "quantum dots."

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Chapters IV and V focus on the electronic structure and transport properties of these silicon based thin films. Chapter IV concerns itself with amorphous films, while Chapter V deals with microcrystalline film properties. Two invited papers in Chapter IV, an experimental one by Craig Taylor (University of Utah) and a theoretical one by David Drabold (Ohio University) discuss the basic nature of bandtail states and other defects in amorphous silicon. Many of the other papers in this chapter are concerned with fundamentals of carrier transport and, in particular, how this relates to electrical noise. Next, Chapter V explores the fundamental properties of *microcrystalline* silicon through a variety of studies. Clearly, this is a subject still in an exploratory stage, and this Chapter reflects the multitude of techniques being applied to understand the complex range of materials labeled as "microcrystalline silicon."

Chapters VI and VII collect together the papers dealing with two of the oldest (and probably related) fundamental issues in this class of materials: hydrogen microstructure and metastability. Chapter VI begins with an invited paper by Dan Leopold (Washington University) that provides some nice examples of what can be learned about the nature of hydrogen in amorphous silicon using NMR. This chapter also includes an invited paper by Norbert H. Nickel (Hahn-Meitner-Institut Berlin) which focuses on hydrogen microstructure in hydrogenated microcrystalline silicon.

Chapter VII on metastability contains a couple of papers proposing new models for metastable defect creation, including an invited paper by Ralf Wehrspohn (Philips Research Laboratories and Max-Planck-Institute Halle). Chris R. Wronski and colleagues at Penn State University present an invited paper that provides one of the best roadmaps to date for correlating the degradation of the electronic properties in polycrystalline and amorphous silicon films with the degradation of matched solar cells. This Chapter also contains a very interesting invited paper by Hikaru Kobayashi (Osaka University) as well as a paper by Howard M. Branz (NREL) suggesting how stability can actually be improved through special post deposition treatment methods. Finally, it includes a potentially very exciting result by Tining Su and co-workers at the University of Utah, in collaboration with scientists at BP Solar, which demonstrates a metastable hydrogen center in a-Si:H which may have a direct connection with light induced deep defect creation.

Chapter VIII covers alloys involving elements other than silicon (plus hydrogen): four papers on silicon-nitride, four on alloys with germanium, and two dealing predominantly with silicon carbide.

The final three Chapters focus on devices. Chapter IX collects papers dealing with photovoltaic devices based on either amorphous or microcrystalline (or mixed phase) materials. Many of these papers explore methods that increase the deposition rate while maintaining good overall device efficiencies. One very provocative invited paper by Jeffrey Yang and co-workers (United Solar System Corp.) examines the degradation properties of cells using a mixed phase i-layer with varying microcrystalline fractions.

Chapters X focuses on thin film transistors, as well as related types of imaging and sensing arrays. A paper by Jengping Lu (Xerox PARC) provides a nice overview of the current state-of-the-art of flat panel imagers, and an invited paper by Helena Gleskova (Princeton University) shows how mechanical strain affects the performance of thin film transistors. Chapter XI contains papers related to novel device structures and to new types of technologies being developed using amorphous/heterogeneous thin film silicon based materials. Virginia Chu (INESC, Lisbon), in her invited paper, describes some of what has been happening in the microelectromechanical (MEMS) applications of a-Si:H. Other types of novel devices described in this chapter include metal/a-Si:H switching devices, a test of a vertical TFT design, ultra-sensitive photodetector devices, and a memory device based upon nanocrystalline quantum dots.

On behalf of all of our participants, the organizers wish to thank the financial supporters of Symposium A. These organizations include: BP Solar, EPRI, Hewlett Packard, MVSystems,

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NREL, Sanyo Electric, United Solar Systems Corp., Voltaix, and Xerox PARC. The organizing committee also particularly wishes to thank Mary Ann Woolf of the University of Utah for her invaluable help preparing this proceedings, as well as for all her other help that was so instrumental in making this year's Symposium A such a success.

Finally, we were greatly saddened by the death of one of this year's symposium organizers, James B. Boyce of Xerox PARC. This occurred early in January 2002, shortly after our program had been put together. Jim had been an active member of the amorphous silicon scientific community for over 15 years, and served as an organizer of Symposium A for the past two years. Because of this, and particularly because of the great appreciation and affection many of us have had for Jim over the years, we have dedicated this year's Symposium A to his memory. Our Symposium included a short memorial session to recall his scientific contributions to our field and to appreciate his warm-hearted sense of humor. Speaking for everyone who knew him, he will be badly missed.

J. David Cohen
John R. Abelson
Hideki Matsumura
John Robertson

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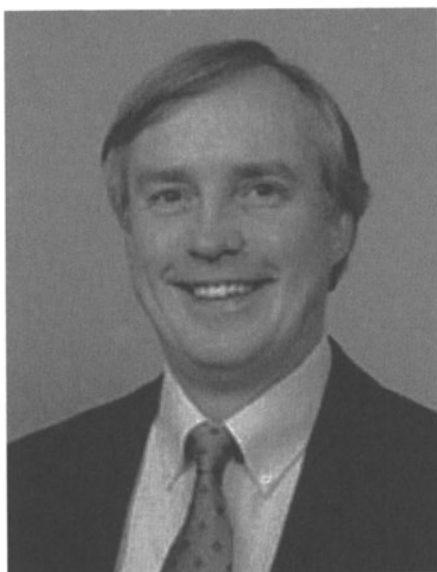
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DEDICATION



James B. Boyce
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