Amorphous and Microcrystalline Silicon Technology—1998

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EDITORS:

Ruud Schropp
Utrecht University
Utrecht, The Netherlands

Howard M. Branz
National Renewable Energy Laboratory
Golden, Colorado, U.S.A.

Michael Hack
dpiX, A Xerox Company
Palo Alto, California, U.S.A.

Isamu Shimizu
Tokyo Institute of Technology
Yokohama, Japan

Sigurd Wagner
Princeton University
Princeton, New Jersey, U.S.A.

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PREFACE

The symposium “Amorphous and Microcrystalline Silicon Technology—1998” was the sixteenth in the MRS Spring Meeting series. The focus of this symposium is no longer limited to hydrogenated amorphous silicon (a-Si:H), as researchers in the field are aware that the distinction between short- and medium-range order, and between homogeneous and heterogeneous semiconductor materials, is indeed difficult to maintain.

This symposium covered amorphous and microcrystalline silicon from materials physics to new applications. The application in thin-film transistors for large-area displays was the subject of a joint session with the symposium “Flat-Panel Display Materials and Large-Area Processes.” Further, this symposium featured special focused sessions on heterogeneous materials, color sensors and radiation imaging, and parameter extraction and device modelling.

S. Guha, of United Solar, illustrated the disappearing distinction between amorphous and nanocrystalline silicon by summarizing the present state in which growth experiments, structural analysis, and device fabrication are directed to the understanding and utilization of heterogeneity in amorphous and microcrystalline films. P. Roca, of Ecole Polytechnique, Palaiseau (Paris), described the deposition of just such films with medium-range order from clusters formed in the glow discharge. A. Howling, of EPF Lausanne, analyzed these negatively charged silicon clusters, containing up to 60 Si atoms, by light scattering, infrared absorption, and mass spectrometry. P.M. Voyles, of the University of Illinois, Urbana-Champaign, described the application of variable-coherence electron microscopy, a new technique, to the identification of fine-grained local order.

Y.F. Zhang, of the City University of Hong Kong, presented a new form of silicon—silicon nanowires—made by laser ablation of silicon, followed by condensation in a steep temperature gradient. G.L. Kong, of the Chinese Academy of Science in Beijing, presented a photodilation effect in a-Si:H, which stimulated a vigorous discussion of the experimental techniques employed and the possible structural changes associated with the Staebler-Wronski (S-W) effect. H.M. Branz, of NREL, presented a new model for the S-W effect, in which the recombination of two photogenerated diffusing hydrogen atoms on one Si-Si bond leaves behind two spatially separated silicon dangling bonds. X. Liu, of Cornell University, applied the recent discovery of extremely low internal friction in a-Si:H at cryogenic temperatures to the observation of the triple point and the ortho-para conversion of molecular hydrogen occluded in films grown by the hot wire technique. These observations nicely complement earlier ones made by Raman spectroscopy at Bell Labs and by NMR at Xerox PARC.

The selective crystallization of a-Si:H allows one to combine the advantages of the low leakage current of a-Si:H thin-film transistors (TFTs) with the high currents and CMOS capability provided by polysilicon. P. Mel, of Xerox PARC, described selective laser crystallization and a complete top-gate process for making a-Si:H and poly-Si TFTs. K. Pangal, of Princeton University, showed a
relatively fast and selective crystallization by furnace anneal following exposure
to a hydrogen discharge.

United Solar, ECD, NREL, and Kaneka described recent progress in solar cell
efficiencies. Amorphous silicon is also applied in X-ray detector arrays, which
provide high-resolution real-time electronic observation and are on the verge of
market introduction. M. Boehm, of the University of Siegen, Germany, showed
the variety of applications that can be satisfied with imagers based on a-Si:H
photodetectors integrated with application-specific integrated circuits (ASICs).
This is a field of considerable activity at present. Finally, M. Boucinha, of INESC
at Lisbon, made a first step to micromachined silicon-on-glass by demonstrating
an a-Si:H TFT using an air gap as the gate dielectric.

On behalf of all of the participants of the 1998 symposium, we thank
Akzo Nobel, dplX-A Xerox Company, Fuji Electric Corporate Research and
Development, Ltd., Kaneka Corp., Mitsui Chemical Co., Ltd., NAPS France,
National Renewable Energy Laboratory, Sanyo Electric Co., Ltd., Tokuyama Corp.,
and Voltaix, Inc. for their financial support. The Organizing Committee is
grateful to this year's Program Advisory Committee, consisting of Howard Branz
(co-chair), Jun-ichi Hanna, Stephen M. Gates, Michio Kondo, Rodrigo Martins,
Hannes Meier, Seiichi Miyazaki, Fabrizio Palma, Terry Peterson, Ruud Schropp
(chair), Bob Street, and Sigurd Wagner (co-chair) for indicating appropriate
candidates as invited speakers and for rating the abstracts within the short time
available and thus contributing to a well-balanced and successful program.
Finally, we wish to express our gratitude to Craig Taylor, and above all, to
Mary Ann Woolf for organizational assistance that has made the symposium and
these proceedings a great success.

Ruud Schropp
Howard M. Branz
Michael Hack
Isamu Shimizu
Sigurd Wagner

August 1998
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