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Amorphous and Heterogeneous Silicon Thin Films: Fundamentals to Devices—1999

Editors: Howard M. Branz, Robert W. Collins, Hiroaki Okamoto, Subhendu Guha

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PREFACE

"Amorphous and Heterogeneous Silicon Thin Films: Fundamentals to Devices—1999," Symposium A at the 1999 MRS Spring Meeting in San Francisco, California, was the seventeenth MRS Spring Meeting symposium to focus on hydrogenated amorphous silicon (a-Si:H), and the third of these symposia with an equal emphasis on microcrystalline thin films. Applications requiring large-area semiconductor coverage rely increasingly on amorphous and heterogeneous silicon materials because they can be deposited at low cost on a variety of substrates. The symposium covered a wide range of topics, from fundamental research on materials to their many device applications. Two joint sessions on thin-film transistors and displays were held with Symposium B, "Flat Panel Displays and Sensors—Principles, Materials and Processes." The papers from these joint sessions are divided between this volume and Volume 558 of the MRS Symposium Proceedings series.

The symposium featured a special session on medium-range order; it has become clear that ordering correlates with the electronic quality of a-Si:H films. Murray Gibson of Argonne National Laboratory reported multi-atom correlations extending to about 1.6 nm in a-Si:H, observed by variable-coherence transmission electron microscopy. Amorphous silicon may resemble paracrystalline structures more than the continuous random networks that have long been used for modeling; the boundary between amorphous and microcrystalline silicon is not so abrupt as once believed. Jeffrey Yang of United Solar Systems Corp. reported a world-record 10.5%-efficient, 920-cm², a-Si:H photovoltaic panel, which utilizes amorphous films deposited by plasma CVD at growth parameters just short of the threshold for a transition to microcrystallinity. Don Williamson of the Colorado School of Mines described a narrowing of the first x-ray diffraction peak in these amorphous films that also suggests ordering at 10–30 nm length scales.

Important new experimental observations on metastable effects in a-Si:H were reported. Shuichi Nonomura of Gifu University (Japan) described a metastable volume expansion of about 4 ppm caused by illumination and measured with a sensitive optical-lever bending technique. Stephen Heck of the National Renewable Energy Laboratory showed pulsed-illumination photoconductivity decays that suggest metastable degradation is delayed by about 1 ms after illumination begins. Discussions about H configurations in a-Si:H were spirited. Rafaella Borzi of Washington University showed deuteron magnetic resonance spectra suggesting up to 40% of the H in a-Si:H is found as H₂ molecules in interstitial sites, while Tining Su of the University of Utah reported NMR measurement indicating only about 10%.

Exciting new devices and processing strategies were reported. Kiran Pangal of Princeton University won a Graduate Student Award for fabricating amorphous and microcrystalline thin-film transistors in a single Si film. He exploited the reduction in crystallization time caused by local H plasma treatment. Ruud Schropp of the

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University of Utrecht (The Netherlands), in collaboration with a consortium of Dutch universities and Akzo Nobel Chemicals and Coatings, is developing a temporary-superstrate technique for a-Si:H photovoltaic manufacture. In a particularly entertaining presentation, Joao Conde of the Instituto Superior Tecnico (Portugal) showed dramatic micrographs of 20-micron-long bridges, cantilevers and even working MEMS transistors fabricated from a-Si:H.

On behalf of all participants, the organizers thank the financial sponsors of this symposium:

Akzo Nobel Chemicals and Coatings
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The organizing committee is grateful to Peter Fedders, Ping Mei, Fujio Okumura, Milan Vanecek, and Sigurd Wagner for their important help with program selection. Craig Taylor provided vital assistance to the symposium at key moments. Finally, we are deeply grateful to Mary Woolf of the University of Utah for her highly professional organizational assistance, which made the symposium and these proceedings a great success.

Howard M. Branz
Robert W. Collins
Hiroaki Okamoto
Subhendu Guha
Ruud Schropp

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