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Microcrystalline Semiconductors: Materials Science & Devices

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Microcrystalline Semiconductors: Materials Science & Devices

Symposium held November 30-December 4, 1992, Boston, Massachusetts, U.S.A.

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Microcrystalline Semiconductors: Materials Science & Devices

Preface

This book contains the proceedings of the symposium on Microcrystalline Semiconductors: Materials Science & Devices, held during the 1992 Fall Meeting of the Materials Research Society in Boston. A similar symposium was held three years ago (MRS Symposium Proceedings Volume 164) and because significant progress had been made since 1989, the consensus of the community was that the symposium should be repeated. The present symposium was organized by P.M. Fauchet (University of Rochester) and C.C. Tsai (Xerox Palo Alto Research Center), who were both involved with the 1989 symposium, together with L.T. Canham (Defence Research Agency, Malvern, U.K.), I. Shimizu (Tokyo Institute of Technology, Japan), and Y. Aoyagi (RIKEN, Japan).

Microcrystals and nanocrystals form a class of materials that are neither amorphous nor single crystalline. Many of their properties are unusual; for example, the electronic and chemical properties are strongly influenced by the surfaces or interfaces and quantization affects the electronic states. As a result, micro- and nano-crystalline semiconductors display unique properties that may be exploited in novel devices. The four and one-half day long symposium brought together materials scientists, engineers, device physicists, chemists and solid state physicists who are active in various areas of growth, characterization, modelling and device applications of micro- and nano-crystalline semiconductors. Approximately 180 papers and posters were presented during the symposium, with a large contingent coming from Europe and Japan. All papers were refereed and 75% of them are included in this volume. For convenience, the papers are grouped in three sections although it was clear during the symposium that there were many issues in common between the three areas.

The first section deals with various aspects of light-emitting porous silicon and related nanostructural materials. Since the demonstration in 1990 that bright, visible light can be emitted by porous silicon, the field has expanded considerably. The symposium attracted numerous contributed papers in this new area. The invited papers are by J. Farr (University of Birmingham, U.K.), Y. Masumoto (University of Tsukuba, Japan), P. Badoz, (CNET, France), N. Koshida (Tokyo University of Agriculture and Technology, Japan), and W. Lang (Fraunhofer Institute, Germany). The field has progressed considerably since the post-deadline symposium held during the 1991 Fall MRS Meeting (MRS Symposium Proceedings Volume 256). Among the highlights are the demonstration of blue photoluminescence and electroluminescence, and the fabrication of relatively stable light-emitting diodes. Although there is still no general agreement on the mechanisms of the luminescence, many of the early hypotheses have been discredited and a comprehensive physical and chemical picture of light-emitting porous silicon is in sight. The papers in this section are grouped under five headings:

1. Silicon and germanium nanostructure fabrication
2. Porous silicon characterization
3. Porous silicon passivation/depassivation
4. Electroluminescent and other devices with porous silicon
5. Silicon nanostructure theory

The second section deals with microcrystalline and polycrystalline silicon film growth and device applications. This constitutes the historical core of the symposium. A large number of contributed papers were presented. The invited papers are by G. Lucovsky (North Carolina State University), B. Drevillon (Ecole Polytechnique, France), L. Yang (Solarex Corp.), T. Sameshima (Sony, Japan), and T. Dyer (University of Swansea, U.K.). Significant progress has occurred since 1989, in terms of understanding the chemistry of deposition, the electronic and optical properties of

microcrystalline films, the effect of various treatments, and the means of fabricating high quality devices. The papers in this section are grouped under three headings:

1. Microcrystalline silicon
2. Polysilicon
3. Laser and thermal processing

The third section deals mostly with quantum wires and quantum dots made of III-V and II-VI semiconductors. Major advances have been made in this area since 1989, and some of the most important of them were reported in the symposium. The number of contributed papers increased considerably compared to 1989, and the invited paper is by T. Fukui (Hokkaido University, Japan). Perhaps the most significant development is the ability to manufacture high quality nanostructures through sophisticated growth procedures and processing. The papers in this section are grouped under three headings:

1. III-V quantum dots and wires
2. II-VI quantum dots and wires
3. Other nano/micro-crystalline structures

The organizers wish to thank the numerous referees and all the authors for working under a very tight schedule, and all the invited speakers and session chairs for their essential contributions. Thanks also go to Ms. JoAnn D'Angelo for her help in preparing this volume. Finally, the following sponsors made this symposium possible:

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