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## Contents

**PREFACE**  

**PART I: GROWTH AND CRYSTALLIZATION**  

**THERMODYNAMIC STUDY OF SILANE-HYDROGEN CHEMICAL SYSTEMS**  
R.I. Patel  

**ELECTRICAL AND OPTICAL PROPERTIES OF PECVD AMORPHOUS SILICON GROWN AT LOW FREQUENCIES**  
W.W. Piper and G.E. Possin  

**PROPERTIES OF INTRINSIC a-Si FILMS DEPOSITED FROM HIGHER ORDER SILANES BY CHEMICAL VAPOR DEPOSITION**  
R.E. Rocheleau, S.S. Hegedus, and B.N. Baron  

**HYDROGENATED AMORPHOUS SILICON FILMS BY THE PYROLYSIS OF DISILANE**  

**DUAL-CHAMBER PLASMA DEPOSITION OF a-Si:H SOLAR CELLS AT HIGH RATES USING DISILANE**  
G. Rajeswaran, P.E. Vanier, R.R. Corderman, and F.J. Kampaas  

**AMORPHOUS SILICON FILMS AND SOLAR CELLS PREPARED BY MERCURY-SENSITIZED PHOTO-CVD OF SILANE AND DISILANE**  
A.E. Delahoy, B. Doele, F.B. Ellis, Jr., K.R. Ramaprasad, T. Tonon, and J. Van Dine  

**FABRICATION OF AMORPHOUS SILICON DEVICES ON PLASTIC SUBSTRATES**  

**HIGHLY CONDUCTIVE AND WIDE BAND GAP MICROCRYSTALLINE SILICON FILMS PREPARED BY PHOTOCHEMICAL VAPOR DEPOSITION AND APPLICATIONS TO DEVICES**  
S. Nishida, H. Tasaki, M. Konagai, and K. Takahashi  

**SELECTED AREA EPITAXIAL REGROWTH OF AMORPHOUS Si/(100) SI STRUCTURES BY LASER ANNEALING**  
A. Christou, C. Varmazis, T. Efthimiopoulos, and C. Fotakis  

**PART II: DEFECTS**  

**DEFECTS IN TETRAHEDRALLY COORDINATED AMORPHOUS SEMICONDUCTORS**  
P.C. Taylor  

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200x503
vii
DETERMINATION OF DENSITY OF LOCALIZED STATES IN AMORPHOUS SILICON ALLOYS FROM THE LOW FIELD CONDUCTANCE OF THIN N-I-N DIODES
M. Shur and M. Hack

PART III: INTERFACES

TRANSIENT PHOTOCONDUCTIVITY STUDIES OF a-Si:H INTERFACES
R.A. Street

RECOMBINATION UNDER DOUBLE INJECTION CONDITIONS IN a-Si:H BASED DIODES
R. Konenkamp and A. Madan

PHOTOEMISSION STUDIES OF AMORPHOUS SILICON/GERMANIUM HETEROJUNCTIONS
F. Evangelisti, S. Modesti, F. Boscherini, F. Fiorini, C. Quaresima, M. Capozi, and P. Perfetti

MINORITY CARRIER INJECTION AND SERIES RESISTANCE EFFECTS IN HYDROGENATED AMORPHOUS SILICON SCHOTTKY BARRIER DIODES
J. Kanicki

PHOTOELECTRONIC PROPERTIES OF AMORPHOUS SILICON/SILICON OXIDE HETEROSTRUCTURES
F. Carasco, J. Mort, F. Jansen, and S. Grammatica

PART IV: MULTILAYERED STRUCTURES

AMORPHOUS SEMICONDUCTOR MULTILAYER STRUCTURES: INTERFACE AND LAYER THICKNESS EFFECTS IN PHOTOLUMINESCENCE
T. Tiedje

PHOTO-INDUCED EXCESS CONDUCTIVITY IN DOPING MODULATED AMORPHOUS SEMICONDUCTORS
J. Kakalios and H. Fritzsche

PART V: Si-Ge ALLOYS

LOCAL BONDING IN a-Si,Ge ALLOY FILMS
G. Lucyovsky, R.A. Rudder, J.W. Cook, Jr., and S.Y. Lin

ELECTRONIC AND OPTICAL PROPERTIES OF a-(Si,Ge):H ALLOYS
V. Dalal, J.P. Booker, and M. Leonard

PREPARATION OF a-(Si,Ge):H ALLOYS BY D. C. GLOW DISCHARGE DEPOSITION
D. Slobodin, S. Aljishi, R. Schwarz, and S. Wagner

AMORPHOUS SILICON-GERMANIUM DEPOSITED BY PHOTO-CVD
H. Itozaki, N. Fujita, and H. Hitotsuyanagi
AN ASSESSMENT OF a-SiGe:H ALLOYS WITH A BAND GAP OF 1.5 eV AS TO THEIR SUITABILITY FOR SOLAR CELL APPLICATIONS
B. Von Roedern, A.H. Mahan, T.J. McMahon, and A. Madan 167

PART VI: Si-C ALLOYS

PHOTOCONDUCTIVE AMORPHOUS SILICON CARBIDE PREPARED BY INTERMEDIATE SPECIES SiF2 AND CF4 MIXTURE
H. Matsumura, T. Uesugi, and H. Ihara 175

THE INFLUENCE OF PLASMA EXCITATION FREQUENCY ON THE PROPERTIES OF a-SiC:H PRODUCED IN A GLOW DISCHARGE PLASMA
W.D. Partlow and H. Herzig 181

BONDING AND RELEASE OF HYDROGEN IN a-Si:C:H ALLOYS
W. Beyer, H. Wagner, and H. Mell 189

GAP STATES IN HYDROGENATED AMORPHOUS SILICON–CARBON ALLOYS
P. Fiorini, F. Evangelisti, and A. Prova 195

PART VII: Si-N ALLOYS

PROPERTIES OF a-SiN:H FILMS PREPARED BY GLOW DISCHARGE OF Si2H6-NH3 GAS MIXTURE

PHOTOCONDUCTIVITY OF BORON DOPED a-SiN:H

DEFECT STATES IN SILICON NITRIDE
J. Robertson and M.J. Powell 215

PART VIII: MISCELLANEOUS ALLOYS

ON THE ELECTRONIC PROPERTIES OF SILICON-TELLURIUM FILMS
F.A. Faris, A. Al-Jassar, F.G. Wakim, and K.Z. Botros 225

THE FIRST TETRAHEDRALLY BONDED DIAMOND-LIKE COMPOUNDS WITH METALLIC CONDUCTIVITY
Y. Sawan 231

PART IX: SOLAR CELLS

RECENT PROGRESS OF AMORPHOUS SILICON SOLAR CELL TECHNOLOGY
Y. Hamakawa 239

CRITICAL MATERIALS PARAMETERS FOR THE DEVELOPMENT OF AMORPHOUS SILICON ALLOYS
S.R. Ovshinsky and D. Adler 251

ix
THIN FILM SILICON POWER MODULES: CHALLENGES AND OPPORTUNITIES FOR MATERIALS SCIENCE  
D.L. Morel 265

HIGH PERFORMANCE a-Si SOLAR CELLS AND NARROW BANDGAP MATERIALS  

RESEARCH PROGRESS IN THE DOE/SERI AMORPHOUS SILICON RESEARCH PROJECT  
E. Sabisky, W. Wallace, B. Stafford, K. Sadlon, and W. Luft 281

TUNNELLING CONTRIBUTIONS TO NIP AND PIN HYDROGENATED AMORPHOUS SILICON DEVICES  
T.J. McMahon and A. Madan 287

PART X: STABILITY

REVERSIBLE, LIGHT INDUCED CHANGES IN a-Si:H FILMS AND SOLAR CELLS  
C.R. Wronski 295

LIGHT-INDUCED METASTABLE DEFECTS IN a-Si:H: TOWARDS AN UNDERSTANDING  
M. Stutzmann, W.B. Jackson, and C.C. Tsai 301

CAPACITANCE STUDIES OF LIGHT-INDUCED EFFECTS IN UNDOPED HYDROGENATED AMORPHOUS SILICON  
K. Zellama, J.B. Cohen, and J.P. Harbison 311

STABILITY OF P-I-N AMORPHOUS SILICON SOLAR CELLS WITH BORON-DOPED AND UNDOPED I-LAYERS  
A. Catalano, R.R. Arya, and R.C. Kerns 317

ENHANCED STABILITY OF AMORPHOUS SILICON PIN SOLAR CELLS BY DOPING PROFILES  
M. Moeller, H. Kausche, E. Guenzel, W. Juergens, and W. Stetter 325

A CARRIER LIFETIME MODEL FOR THE OPTICAL DEGRADATION OF AMORPHOUS SILICON SOLAR CELLS  
Z.E. Smith and S. Wagner 331

PART XI: THIN FILM-TRANSISTORS AND SWITCHING DEVICES

AMORPHOUS SILICON THIN-FILM TRANSISTORS AND MEMORY DEVICES  
P.G. LeComber 341

SHORT CHANNEL AMORPHOUS SILICON MOS STRUCTURES WITH REDUCED CAPACITANCE  
Z. Yaniv, V. Cannella, G. Hansell, and M. Vijan 353
AMBIPOLAR FIELD EFFECT TRANSISTOR
H. Pfleiderer and W. Kusian 361

CONTINUED DEVELOPMENT OF R. F. SPUTTERED a-Si:H THIN-FILM TRANSISTORS TOWARDS AN ALL-SPUTTERED DEVICE
J. Allison, D.P. Turner, and D.C. Cousins 367

EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE ABOVE THRESHOLD CHARACTERISTICS OF AMORPHOUS SILICON ALLOY FIELD EFFECT TRANSISTORS
M. Hack, M. Shur, C. Hyun, Z. Yaniv, V. Cannella, and M. Yang 373

A HIGH-SPEED AMORPHOUS-SILICON DYNAMIC CIRCUIT
H. Okada, Y. Nara, Y. Uchida, Y. Watanabe, and M. Matsumura 379

AN ACTIVE MATRIX LIQUID CRYSTAL DISPLAY USING A NOVEL AMORPHOUS SILICON SWITCHING DEVICE
W. Den Boer, J.S. Payson, G. Skebe, L. Swartz, and Z. Yaniv 385

CONDUCTION AND THRESHOLD SWITCHING IN AMORPHOUS SILICON
A. Sa-Neto 389

PART XII: PHOTORECEPTORS

PROBLEMS IN a-Si PHOTOELECTRIC DEVICES: PHOTORECEPTOR AND VIDICON
I. Shimizu 395

HIGH DEPOSITION RATE AMORPHOUS SILICON ALLOY XEROGRAPHIC PHOTORECEPTOR
S.J. Hudgens and A.G. Johncock 403

CHARACTERISTICS OF THE BLOCKING LAYERS IN THE a-Si:H PHOTORECEPTOR
H. Kakinuma, S. Nishikawa, T. Watanabe, and K. Nihei 409

PART XIII: IMAGE SENSORS

AMORPHOUS SILICON LINEAR IMAGE SENSOR
T. Ozawa, M. Takenouchi, and S. Tomiyama 417

AMORPHOUS Si:H HETERJUNCTION PHOTODIODE AND ITS APPLICATION TO A COMPACT SCANNER
S. Raneko, Y. Kajiwara, F. Okumura, and T. Ohkubo 423

INFLUENCE OF TRANSPARENT ELECTRODES ON IMAGE SENSOR PERFORMANCE
K. Kempter, H. Wieczorek, and M. Hoheisel 429
PART XIV: HETEROJUNCTION AND POLYCRYSTALLINE DEVICES

THE USE OF AMORPHOUS SILICON EMITTERS IN BIPOLAR TRANSISTORS
M. Ghannam, J. Nijs, R. De Keersmaecker, and R. Mertens 437

HIGH PERFORMANCE POLYCRYSTALLINE SILICON THIN FILM DEVICES
W.G. Hawkins 443

AUTHOR INDEX 449

SUBJECT INDEX 451
Preface

Over the past few years, the present and potential applications of amorphous-silicon-alloy thin films have mushroomed, and interest in the materials as well as in the device has grown accordingly. The field has evolved rapidly since the accidental discovery of hydrogenated amorphous silicon (a-Si:H), an alloy whose semiconducting properties proved much superior to those of pure amorphous silicon because the overall reduction of network strains due to the univalency of hydrogen taken together with the strength and polarity of the Si-H bond leads to sharp reductions in the concentrations of both traps and recombination centers in a-Si:H. The initial application of a-Si:H and related alloys such as a-Si:F:H was in the area of photovoltaic energy conversion, since here the cost of devices based on crystalline silicon (c-Si) precluded their widespread use on economic grounds. The development of large area photovoltaic devices further stimulated the field, and even a continuous-web process has been demonstrated. Since it is also possible to tune the bandgap using, for example, Si-Ge and Si-C alloy films, the possibility of ultra-high-efficiency multiple-gap stacked solar cells is particularly exciting. Unfortunately, high-quality hydrogenated amorphous Si-Ge and Si-C alloys initially proved to be more difficult to develop than a-Si:H, but recent progress especially with alloys also incorporating fluorine has been very encouraging. Another potential cloud has been the metastable instabilities that characterize a-Si:H films exposed to sunlight for extended periods, but again recent advances in both understanding the effect and judicious processing of the materials and the overall device geometry has suggested that any stability problem can be overcome.
The demonstration of large-area processing of high-quality films has also revived interest in the fabrication of thin-film transistors, especially for use in flat-screen displays. Another potentially enormous application of amorphous silicon alloys, viz. as the photoreceptor for electrostatic copying, requires rapid deposition rates, and here again recent progress has been extremely exciting. The development of amorphous-silicon-alloy photodiodes for use in image sensors and compact scanners has also evolved rapidly, as has the materials use in switching and memory applications, in laser printers, and in an array of other possibilities.

Concomitant with this exponential growth in the device potential, there has been further progress in materials processing. Novel approaches to chemical vapor deposition have been developed and periodic multilayer structures have been shown to exhibit unique properties such as persistent photoconductivity (for several hours at room temperature). Clearly, the entire area is in a period of rapid growth.

It was in this milieu that the MRS Symposium on Materials Issues in Applications of Amorphous Silicon Technology took place in April 1985. Over 200 scientists from around the world participated. The present volume contains 60 papers, including all the invited presentations as well as the vast majority of both the oral and poster contributions. The volume is divided into 14 parts, and is concerned with both materials processing and characterization as well as device applications. Part I contains nine papers devoted to the deposition, growth, and crystallization of amorphous-silicon-alloy films. In particular, there has been a great deal of recent interest in alloys prepared by chemical vapor deposition, especially from disilane (to keep the temperature sufficiently low to insure that significant concentra-
tions of residual hydrogen are incorporated in the films. Since the quality of the material is directly related to the defect concentration, the overall issue of defects is of vital importance. The two papers of Part II are concerned with both the nature and the physical consequences of defects in amorphous-silicon-alloy films.

All devices involve interfaces between the amorphous silicon alloy and other semiconductors, metals, or insulators. The five papers in Part III deal with the properties of a variety of such interfaces, all of potential commercial importance. As an interesting extension of some of these considerations, Part IV consists of two papers on novel periodic multilayer devices employing alternating amorphous-silicon-alloy films of individual thicknesses as low as 10 Å.

The 14 papers comprising Parts V through VIII are all concerned with alloys, especially those useful for bandgap modulation. In particular, Si-Ge alloys are the subject of Part V, Si-C alloys of Part VI, Si-N alloys are discussed in Part VII, and the properties of some miscellaneous alloys are reviewed in Part VIII. The large fraction of the present volume devoted to alloys reflects the excitement attendant with the possibility of stacked high-efficiency solar cells for use in central-power generation.

The remainder of the volume is directly concerned with specific applications. The six papers of Part IX make clear the striking advances in solar-cell technology that have occurred over the last year, while the six papers of Part X demonstrate how our understanding of photo-induced effects in these films has progressed concomitantly. Part XI consists of eight papers, more than one-quarter of all the papers deal with devices, all concerned with the physics and performance of thin-film transistors and diodes involving amor-
phous-silicon-alloy films. The papers in Part XII are devoted to photoreceptor applications, while image sensors and related devices are discussed in Part XIII. Finally, the two papers of Part XIV analyze amorphous-crystalline heterojunction transistors and thin-film devices involving polycrystalline silicon. Taken together, the 29 papers concerned with devices eloquently demonstrate the current state of the art.

We the organizers were pleasantly surprised with the strong positive response to the symposium. It was unanimously decided to hold a similar symposium at the 1986 MRS Spring Meeting. From our present perspective, it would appear that even a more enthusiastic response may well result next year.

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