ENERGY
and the
ENVIRONMENT
Into the 1990s
Proceedings of the 1st World Renewable Energy Congress,
Reading, UK, 23–28 September 1990
Edited by
A. A. M. SAYIGH
Department of Engineering, University of Reading, UK
Organized by
WORLD RENEWABLE ENERGY COMPANY LIMITED
Volume 1
CONTENTS OF VOLUME 1

PLENARY PAPERS

Architecture's Balance: Systems, Kits, Myth and Technology
M. Hutchinson, President, Royal Institute of British Architects, London, UK

Passive and Low Energy Architecture - From the Engineering Viewpoint
D.S. Gillingham, President, Chartered Institute of Building Services Engineers, London, UK

Renewable, Clean Energies: Urgency - Solutions - Priorities
Gustav R. Grob, President, CMDC and Chairman, ISO/TC197, Zurich, Switzerland

Renewable Energy and the Developing Countries
P.D. Dunn, Head of Department of Engineering, University of Reading, Reading, UK

Recent Progress of Amorphous Silicon Solar Cells
Yoshihiro Hamakawa, Faculty of Engineering Science, Osaka University, Osaka, Japan

Large Scale Wind Power: A Review
D. Lindley, Managing Director of Wind Energy Group Ltd, Southall, Middlesex, UK

Continuing Long-Term Hydrocarbons' Dominance of World Energy Markets: An Economic and Social Necessity
Peter R. Odell, Director, Centre for International Energy Studies, Faculty of Economics, Erasmus University, Rotterdam, The Netherlands

Solar Energy and Peace
Harry Z. Tabor, Director of The Scientific Research Foundation, Jerusalem, Israel

PHOTOVOLTAIC TECHNOLOGY

Photovoltaics - The Road To Maturity (invited)
P.R. Wolfe, Intersolar Group Ltd, High Wycombe, UK

The Technology of Semicrystalline Silicon Solar Cells (invited)
Von Overstraeten, IMEC-vzw, Leuven, Belgium

The Present Status of Photovoltaic Technology (invited)
M.B. Prince, Photovoltaic Energy Technology Division, Department of Energy, USA

Current Status of Photoelectrochemical Solar Energy Systems
A.J. McEoy and M. Gratzel, Ecole Polytechnique Federale de Lausanne, Switzerland

* unavailable for the proceedings
Properties and Time-Temperature Dependence of the Dark Conductivity of Sputtered CdS Films
A. Bennouna, A. Haouni E.I. Ameziane, Laboratoire de Physique des Solides et des Couches Minces, Faculte des Sciences, Marrakech, Morocco 200

Photovoltaic Power Generation: Economical, Social and Environmental Aspects (invited)
I. Chambouleyron, Campinas State University, Campinas, Brazil 205

Present and Future Status of Utilization of Photovoltaic in People's Republic of China (invited)
Cheng Ru Guang and Hong Jian Jun, Shanghai Institute of Ceramics, China 213

The Technology Issue of Photovoltaic (invited)
Giuliano Martinelli, University of Ferrara, Italy 221

PV Finds Acceptance in the Philippines (invited)
P. de Bakker, Philippine-German Special Energy Program, Quezon City, Philippines 227

Photovoltaic Rural Electrification of Village Hammam Biadha - Tunisia
J. Boukhicha, B. Ben Ghanem and H. Nasri, Societe Tunisienne de L'Electricite et du Gaz, Tunis, Tunisia 229

Stand-Alone Photovoltaics in California
Christina Jennings, Pacific Gas and Electric Company Research and Development, San Ramon, CA, USA 234

PV Rural Electrification in the Bolivian Altiplane
J. Aguilera and E. Lorenzo, Universidad Politecnica de Madrid, E.T.S.I. Madrid, Spain 241

30 kW Photovoltaic Solar Power Plant in The Austrian Alps
Alfred Nentwich and Andreas Szeless, ARGE Alpen Photovoltaic Verbundgesellschaft, Austrian Federal Electricity Board, A-1010 Wien, Austria 246

Environmental Factors Affecting The Performance of Photovoltaic at Cairo
M.A.Mosalam Shaltout and A.H. Hassen, National Reseach Institute of Astronomy and Geophysics, Helwan-Cairo, Egypt 249

Better Design of Photovoltaic Arrays for Shadow Tolerance
A.K. Sharma, N. Dwivedi and B.K. Srivastava, Banaras Hindu University, Varanasi, India 254

Experience with Photovoltaic Systems Use in Ghana
K.G. Adanu, University of Ghana, Legon Accra, Ghana 259

Sun Tracking and Soft Concentration for PV Applications at the Test Field Widderstall
Computer controlled measuring device for voltage-current characteristic of solar generators
S. Hanitsch, G. Duschl and S. Ahmad, Technical University of Berlin, West Germany 269

A Simulation and Optimization Model for Autonomous Energy Systems
V.A.P. van Dijk, E.A. Alsema, K. Blok and W.C. Turkenburg, University of Utrecht, The Netherlands 274

A New Computer Simulation Model for Stand-Alone Photovoltaic Systems
P.C. Geerdts and A.A. Eberhard, Energy Research Institute, University of Cape Town, South Africa 279

A Two-State Markovian Estimation of the Size of Photovoltaic Systems
A. Maafi, A. Adane and M. Benghanem, Universite des Sciences et de la Technologie d'Alger (U.S.T.H.B.), Algiers, Algeria 284

Design Characteristics of Water Pumping with Solar Array Field
Hasan Kulunk, Kocaeli Engineering Faculty, Izmir, Turkey 289

Solar Water Oscillation Pumps for Rural Water Supply
J. E. Manning, G. Cefis and E. Mencarelli, FLUXINOS, Export Office Viale Europe 6/b, Busseno, Italy 294

An Experience on Operation and Maintenance of Duel Photovoltaic Pumping System
A. Lubis, Z. Udin and A.S. Dasuki, BPP Teknologi, Jakarta 10340, Indonesia 299

An Analytical Study of Parameters Effecting the Performance of a Photovoltaic Water Pumping Station
N. A. Al-Rawi, University of Technology, Baghdad, Iraq 304

A Solar Energy Refrigerator with Cold Storage Tank for the Conservation of Vaccines
M. Adj, C. Awanto and A. Girardey, Appliquee, ENSUT B.P., Dakar, Senegal 309

Development of Photovoltaic Systems for Arid Zone of India
P.C. Pande, Central Arid Zone Research Institute, Jodhpur, Rajasthan, India 314

Colloidal Semiconductors in Solar Hydrogen Production
E. Saievar, Tehran University, Tehran, Iran 320

Sewage Plant Powered by Combination of Photovoltaics, Wind and Biogas on the Island of Fehmarn, FRG
E. Krausen and D. Mertig, Telefunken Systemtechnik Gmbh, Space and New Technologies, D-2000 Wedel, F.R. Germany 325

Conflicts of Interest, Social and Technical Rationality: Photovoltaic Applications in a Divided Society
W.D. Cowan, University of Cape Town, South Africa 331

Application of Silicon Photovoltaic Cells in Detection of Electromagnetic Waves
F.A.S. Soliman, M.H. El-Fouly, M. Abdel-Halim and M. El-Ashry, Nuclear Materials Corporation, Cairo, Egypt 337
Electrical Characterization of Solar-Cell CdS - Films  
Jackson M. Odote, Kenyatta University, Nairobi, Kenya  
343

Radiation Damage in Silicon Solar Cell by Helium Ions  
M.S.I. Rageh and F.A.S. Soliman, Nuclear Materials Corporation, Cairo, Egypt  
351

Upgradation of Rice-Husk Silicon for Photovoltaic Applications  
N. Dasgupta, S. Basu and D.N. Bose, Indian Institute of Technology, Kharagpur, India  
357

Characterisation and Evaluation of Efficiency and Degradation of Mono and Polycrystalline Photovoltaic Modules  
A.K. Som and S.M. Al-Alawi, University of Bahrain, Bahrain  
361

X-Ray Diffraction Study of Texture and Growth of R.F. Sputtered CdS Films  
A. Bennouna, A. Haouni, G. Ghermani, E.L. Ameziane and M. Brunel, Faculte des Sciences, Marrakech, Morocco  
366

The Influence of the Capsulation on the Efficiency of PV-Modules  
S. Krauter and R. Hanitsch, Technical University of Berlin, Berlin, F. R. of Germany  
371

Effect of Series Resistance on Solar Cell Performance at High Illumination Levels  
M.B. Saleh, Arab Maritime Transport Academy, Alexandria, Egypt  
376

Complex Impedance Measurements for the Evaluation of Grain Boundary Effects in Polycrystalline Materials for Solar Cell Applications  
M.S. Alaee, University of Tehran, Tehran, Iran  
381

M.K. Al-Mutawakel and S.M. Bin Gadhi, University of Aden, Ma'alla, Aden, People Democratic Republic of Yemen  
386

Operational Constraints on the Introduction of Direct Load Control in Electric Power Systems  
J.R. McDonald, K.L. Lo and H. Maulana, University of Glasgow, UK  
391

Numerical Analysis of Current-Voltage and Spectral Response Characteristics of Solar Cells  
D. Agchbayar, N. Enebish, R.H. Marshall and B.M. Cross, University of Wales, Cardiff, UK  
398

Effect of the Middle N/P Junction on the Properties of Amorphous Tandem Solar Cells  
K. Ibrahim, University of Science of Malaysia, Penang, Malaysia  
407

Cadmium Sulphide - Merocyanine Hetrojunctions  
R.W. Buckley, Twyford Church of England High School, Acton, London, UK  
412
Pr$^{3+}$ - Nd$^{3+}$ Energy Transfer in Zinc Tellurite Glasses used as Luminescent Solar Concentrators
A. Kanoun, S. Alaya and H. Maaref, Faculte des Sciences et Techniques, Monastir, Tunisia 417

CdS Thin Film Characterization: Structure, Cathodo-Luminescence and Photoconductivity
G.H. Talat, National Research Centre, Dokki, Cairo, Egypt 422

The Formation of Sputtered Mo-Si Interfaces
Y. Ijdiyaou, M. Azizan and E.L. Ameziane, Faculte des Sciences, Marrakech, Morocco 428

Photoconductivity and Optical Properties of CuInSe$_2$ Films for Solar Cell Applications
S. Chaudhuri, K.K. Chattopadhyay, I. Sanyal and A.K. Pal, Department of Material Science, Calcutta, India 433

Minority Carrier Diffusion Lengths in InP Single Crystals and CdSe Thin Films
A.K. Pal, I. Sanyal, S. Ghosh, A. Mondal and S. Chaudhuri, Department of Material Science, Calcutta, India 438

Vacuum Deposited CuInS$_2$ Thin Films: Process and Properties
M. Kenzari and B. Rezig, Laboratoire Materiaux et Composants Semiconducteurs, Tunis, Tunisia 443

Theoretical Determination of MIS Solar Cell Characteristics
A. Mhirech and M. Baddi, Faculte des Sciences, Rabat, Morocco 448

Spray Pyrolysis of InS Thin Films
H. Bouzouita, A. Maalej and A. Dhouib, Ecole Nationale d'Ingenieurs de Tunis, Tunis, Tunisia 453

Preparation of Iron Disulfide and Its Use for Solar Energy Conversion
A. Ennaoui, S. Flechter, G. Smestad and H. Tributsch, Hahn Meitner Institut GmbH, Berlin, W. Germany 458

Incorporation of Conservation Measures in Long Term Electricity Demand Forecasting
J.R. McDonald, K.L. Lo and F.M. Taha, University of Glasgow, UK 465

Remote Area Power Supply Systems
Z. Benyahia and B. Ait Driss, HCR/Centre de Developement des Energies Renouvelables, Algiers, Algeria 472

Monitoring the 10 kW$_p$ Photovoltaic Test Facility in Berlin
S. Hanitsch, E.S. Hemead, Technical University of Berlin, Berlin 10, West Germany 476

Design of Photovoltaic Based Remote Area Power Supply for LEH
A. Kumar Saxena, V. Dutta and K.L. Chopra, Indian Institute of Technology, New Delhi, India 481
Accumulation of Electric Energy from Regenerative Sources into Electric Batteries
M. Cenek, J. Kazelle and V. Hodinar, Technical University Brno, Brno, Czechoslovakia

Experiences in Encouraging the Use of Solar Photovoltaic in Indonesia
A. Mostavan, Institute of Technology, Bandung, Indonesia

Photovoltaic Power A Remote Application - Weather Station
R.P. Jetton, Y.B. Safdari and R.A. Peterson, Bradley University, Peoria, Illinois, USA

Solar Powered Lighting System for the Westbank and Gaza Remote Areas
K. A. Nigim-Al Birah, Birzeit University, Gaza Strip, West Bank, via Israel

Performance Characteristics of a Photovoltaic Cells Module at Local Conditions
M. Hammond and M. Mahmoud, STATS, Abu Dhabi, United Arab Emirates

Grazing Incidence X-Ray Diffraction Study of All-Sputtered Al/CdS and CdS/Al Interfaces
A. Bennouna, A. Haouni, G. Ghermani, E.L. Ameziane and M. Brunel, Faculte des Sciences, Marrakech, Morocco