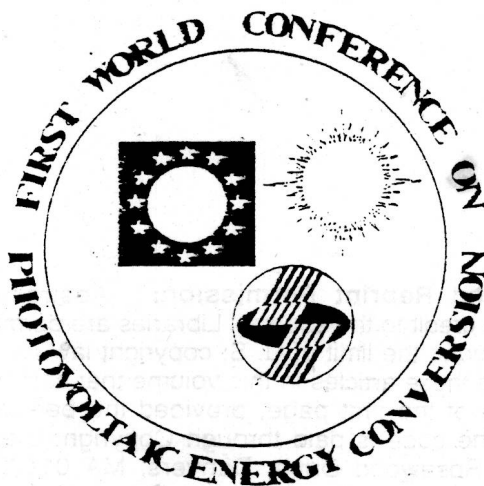


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TWENTY FOURTH IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE-1994

HILTON WAIKOLOA VILLAGE
WAIKOLOA, HAWAII
DECEMBER 5-9, 1994



VOLUME I



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CHAIRPERSON'S MESSAGE

The First World Conference on Photovoltaic Energy Conversion represents a landmark event in our field. It is the first time a jointly planned meeting has ever been held by the three major R&D communities from the U.S., Japan, and Europe. Although it was not necessarily our goal, it also stands as the largest conference to-date dedicated exclusively to photovoltaics. Over 1200 scientists, engineers, government program managers and representatives from industry came together to share results from their research, development, applications experiences and efforts to commercialize photovoltaic technology with attendees from 43 countries around the globe. Though that fact in itself is not significant, what it may mean is. After over three decades of research and development, the reality of a broadly based, large-scale deployment of photovoltaic technology in a variety of commercial applications appears close at hand. This has to come as good news, not only to those of us intimately involved in the field, but to persons around the world who wait patiently for their own entry into the energy sufficiency that the industrialized nations have enjoyed for generations.

As you will discover when you examine these volumes, the conference contained an excellent mix of papers ranging from research reports on a variety of advanced devices to results of pilot commercialization projects. Special highlight sessions and workshops on the more practical problems relating to financing, installing and operating photovoltaic power generating systems were conducted in conjunction with the World Bank, the State of Hawaii, the U.S. Department of Energy and several private concerns as well. A strong area on space photovoltaic device development and system applications was also included.

Two special events were included with this conference. The first was a public exposition held on Sunday, Dec. 4, which provided an opportunity for local residents to gain firsthand knowledge of the potential of photovoltaic power systems, and to view the state-of-the art in commercial products displayed by the nearly 60 companies that filled the exhibits area to overflowing. The second was the school program. Although it is a regular feature of the U.S. IEEE PVSC, and usually involves schools from the immediate vicinity, this program involved all the high schools from the entire State of Hawaii, and included most of the junior high schools from the Island of Hawaii as well. In all, nearly 150 students participated in model solar car competitions and engineering and design projects. Their enthusiasm, energy and creativity are reassurance that staunch advocates for photovoltaic technology will abound in the generations to come.

This conference was organized by combining representatives from the executive committees of the IEEE Photovoltaic Specialists Conference in the U.S., the Photovoltaic Science and Engineering Conference from Japan, and the Photovoltaic Solar Energy Conference from the European Union into one Executive Committee. The dedication and support of each of those individuals is gratefully acknowledged. Over 750 abstracts were received from more than 50 countries, and were carefully reviewed by the program committee; their hard work and dedication to the task of making the content of the meeting as reflective as possible to the total spectrum of interests of each of the three communities was spectacularly successful.

The success of this meeting has created agreement among the three communities to hold such a conference on a four year cycle. Responsibility for hosting it will revolve from one community to the next. It is my pleasure to announce that the Second World Conference on Photovoltaic Energy Conversion will be held in Vienna, Austria in the 1998-1999 time frame. The 2nd WCPEC will mark the first time that all three meetings will be held jointly: The 10th PVSEC, the 15th PSEC and the 27th IEEE PVSC will all be combined into one. Please mark your calendars now for what should be another history-making event.

Dennis J. Flood

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WILLIAM R. CHERRY

The fourteenth IEEE Photovoltaic Specialists Conference organizing committee established an award to recognize persons who have made "outstanding contributions to the advancement of photovoltaic science and technology," and named it in memory of one of the founders of the photovoltaic field, William R. Cherry. The award is to be given at each Photovoltaic Specialists Conference. The selection is made by the William R. Cherry Committee which is composed of all past general chairmen of the specialists conferences (those who may be nominated for the award are not participants in the selection), and all past recipients of the award. Past recipients of this award are Dr. Paul Rappaport, January 1980; Dr. Joseph L. Loferski, May 1981; Prof. Martin Wolf, October 1982; Dr. Henry W. Brandhorst, May 1984; Mr. Eugene L. Ralph, October 1985; Dr. Charles E. Backus, May 1987; Dr. David E. Carlson, September 1988; Dr. Martin A. Green, May 1990; Mr. Peter A. Iles, October 1991; Dr. Lawrence L. Kazmerski, May 1993.



PROFESSOR YOSHIHIRO HAMAKAWA

Professor Hamakawa holds the titles of Professor of the Department of Electrical Engineering, Director of the Institute for Extreme Materials, and Chair of the Semiconductor Laboratory in the Faculty of Engineering Science, Osaka, Japan. He has been with Osaka University since the completion of his MA Degree in 1958. He received the PhD in 1964. From 1965 until 1967 he was visiting Assistant Professor in the Electrical Engineering Department of the University of Illinois, and worked in the semiconductor Laboratory directed by Professors John Bardeen and Paul Handler. He has an extensive record of accomplishment in the fields of Photovoltaics, Semiconductor Physics, and Optoelectronics. He developed the technique of "modulation spectroscopy," now widely used for the characterization of the band structure of solids. He has conducted pioneering work on amorphous silicon multilayer tandem solar cells; demonstrated valence electron control in the production of amorphous silicon carbide films, and showed its applicability to successful fabrication of high efficiency, heterojunction solar cells and light emitting devices. He has authored or co-authored 32 books, 433 scientific research papers, and 135 invited talks.

In addition to these scientific activities, Professor Hamakawa has made many key contributions to the promotion of photovoltaic solar energy technology development around the world. He has been a member of the International Advisory Committee of the IEEE PVSC since 1978, and the EU-PSEC since 1981. He organized the Photovoltaic Science and Engineering Conference (PVSEC) in Japan in 1984, and was chairman of the first conference. He has been an active leader in the industrial development of photovoltaic solar energy, and has been a Board Member for the Sunshine Project since 1973. He is now Chairman of the Solar Energy Division in the New Energy Section, Industrial Development Council, AIST, Ministry of International Trade and Industry of Japan.

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