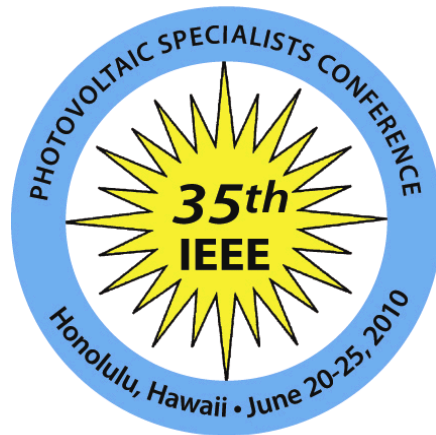


# CALL FOR PAPERS



## THE 35<sup>th</sup> IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE

June 20-25, 2010

Hawaii Convention Center

Honolulu, Hawaii

PLEASE CHECK OUR WEB SITE AT

[www.ieee-pvsc.org](http://www.ieee-pvsc.org)



Sponsored by the IEEE Electron Devices Society

# Invitation from the Chair

On behalf of the Organizing, Cherry, and International Committees, it is my great pleasure to invite you to join the 35<sup>th</sup> IEEE Photovoltaic Specialist Conference, June 20-25, 2010, at the Hawaiian Convention Center in Honolulu, Hawaii. We continue our role as the premier technical conference covering all aspects of PV technology from basic material science to installed system performance. We also continue our Industrial Exhibition that brings our PV Specialists together with the PV industry. Set with the backdrop of tremendous progress in Hawaiian renewable energy initiatives and the beautiful location of Waikiki, this will be THE PV conference in 2010.

Highlights include:

**Strong Technical Program:** In addition to our traditional eight topical areas, we have created a separate Area for Organic Photovoltaics, and we created a new area titled: "Advances in Characterization of Photovoltaics".

**Full Day of Tutorials:** We will have nine tutorials this time, consisting of half-day lectures taught by experts in the field. The topics will range from the basic physics of solar cell operation to details about the latest trends in the industry that will be valuable to newcomers to PV as well as seasoned veterans.

**Industrial Exhibition:** Within the gorgeous Hawaiian Convention Center, our exhibit space will be designed to bring together the commercial sector and the Photovoltaic Technologist. Our focus will be on measurement and characterization tools, and we will be highlighting space PV applications.

**Student Participation:** Our technical community is only as vibrant as our student body, so we have created incentives to encourage students to attend and to be active participants in the conference, including reduced registration and tutorial fees, special student hotel rates, and best student presentation awards in each technical area.

**Hotel Accommodations:** One of our assets is the Photovoltaic Specialists community itself, and our conference provides the meeting place for this community. To maintain our continuity as a community, we are using the Hilton Hawaiian Village as our Base Hotel. Within easy walking distance to the Convention Center, you cannot find a more beautiful location right on Waikiki Beach. We have a low conference rate of \$179/night (the Federal Government rate) and an incentive package for our attendees.

**Auxiliary Program:** We will hold a full agenda throughout the week addressing broader issues within the PV Community. The "PV Velocity Forum" will explore methods to accelerate the transition of new technology from research to market. The "Women in Photovoltaics Symposium" will address the role of women in the historically male-dominated PV World. PV grid integration symposia will benefit from our location since Hawaii has been a leader in PV grid integration and members of the Hawaiian Government and Energy Company will join us.

**Social Program:** Continuing our theme of enhancing our PV Specialists community, our goal is to create relationships on a social as well as professional level amongst our attendees, families, and companions. From the Cherry Award Reception to the Conference Banquet to the daily sightseeing tours, the social program is going to be a blast. Arrive early and stay late!

We urge you to register for the meeting, as well as to make your hotel reservation, well ahead of the deadline. The increased interest PV is likely to lead to greatly increased attendance and the hotel will maintain our group rate and room block for a limited time. Please join us in Honolulu and help to make the 35<sup>th</sup> Photovoltaic Specialists Conference a memorable event.

***Robert Walters***  
***General Chair***

# Call For Papers

## 35<sup>th</sup> IEEE Photovoltaic Specialists Conference

On behalf of the Technical Program Committee, I invite you to submit an abstract on your latest results in photovoltaics research, development, and applications to the 35<sup>th</sup> IEEE PVSC. We are in the midst of a crucial time for energy management on our planet. Environmental, climate change, and energy security concerns are among the most pressing issues we face today. Clearly, photovoltaics can be part of the solution. Public awareness is growing that photovoltaics can shape energy use patterns for future generations – much as the automobile transformed transportation within a time span of 50 years – as evidenced by the exponential rise in photovoltaic production over the last decade. Science and technology developments in PV over the next several years, and their influence on the economics of PV installations, are likely to establish which energy technologies become dominant for decades to come. The chance to share and discuss these crucial PV developments in a timely and influential forum is what the PVSC is all about. Please join us in continuing the PVSC's tradition as the premier international conference on the science and technology of photovoltaics.

Abstracts summarizing original research on all aspects of photovoltaics are encouraged. The technical sessions are organized into 10 major areas as outlined below. We have adopted a system of international chairs and co-chairs for each technical area, to further foster international participation and collaboration at the PVSC.

We have also started two new technical areas at the 35<sup>th</sup> PVSC. In recognition of the rapidly growing interest in organic photovoltaics and dye-sensitized solar cells, which had previously been part of Area 1, we have launched **Area 6: Organic Photovoltaics**. The other new area is **Area 8: Advances in Characterization of Photovoltaics**. Here the focus will be on methods of measurement and analysis themselves, rather than on a particular photovoltaic material system. By breaking these topics out separately in Area 8, it is hoped that researchers will have more exposure to characterization tools typically used for PV materials outside their area of specialization. This cross-fertilization will hopefully give researchers some 'new eyes' with which to look at their PV materials.

To have your paper considered for presentation at the 35<sup>th</sup> PVSC, please submit a 3-page evaluation abstract, and a short abstract no more than 300 words in length for display on the PVSC website, by the deadline below. Other than the 3-page limit, there are no format restrictions on the evaluation abstract, except that it be detailed enough to allow a competent technical review. The preferred way to submit your abstract is via the 35<sup>th</sup> PVSC website at [www.ieee-pvsc.org](http://www.ieee-pvsc.org). Click on "Submit Your Abstract/Manuscript Online" and please follow the instructions line-by-line to upload your abstract successfully. If you are unable to submit your abstract or manuscript electronically, please contact Brent Nelson as soon as possible for instructions:

Brent Nelson, National Renewable Energy Laboratory  
1617 Cole Blvd., Golden, CO 80401  
[brent.nelson@nrel.gov](mailto:brent.nelson@nrel.gov)

The deadline for electronic submission of the 3-page extended abstract and the short abstract of 300 words or less is **February 15, 2010, 12:00 midnight Pacific Standard Time (UTC - 8 hours)**. Contributing authors will be notified of the acceptance status of their papers after March 22, 2010. Upon acceptance, we ask all authors to confirm that they will be able to present their work at the conference, and upload their manuscript by the due date of June 20, 2010 (before the conference) for publication in the conference proceedings. A small number of select papers from the IEEE PVSC are planned to be included in a special journal issue devoted to photovoltaics. Papers in the PVSC proceedings are searchable and accessible via the internet through the IEEE Xplore<sup>®</sup> system. To ensure IEEE Xplore<sup>®</sup>-compliant proceedings, please submit your manuscripts electronically through the website, if at all possible.

Please join us in making the 35<sup>th</sup> PVSC the place to be to present and learn about the latest advances in the science, engineering, and applications of photovoltaics!

**Richard R. King**  
**Program Chair, 35<sup>th</sup> PVSC**

# Technical Areas

## **Area 1: Fundamentals and New Concepts for Future Technologies**

**Chair:** *Ryne Raffaele, National Center for Photovoltaics, Golden, Colorado, USA*

**Co-Chair:** *N. (Ned) Ekins-Daukes, Imperial College, London, United Kingdom*

**Co-Chair:** *Yoshitaka Okada, The University of Tokyo, Japan*

- Subarea 1.1 Fundamental Conversion Mechanisms
- Subarea 1.2 Quantum Dots, Nanowires, and Quantum Wells
- Subarea 1.3 Nanostructures for Hybrid Solar Cells
- Subarea 1.4 Novel Material Systems

Papers are sought that describe basic research in physical, chemical and optical phenomena, new materials and novel device concepts, which are essential to feed the innovation pipeline leading to future-generation PV technologies. General areas of interest include, but are not limited to, synthesis, characterization and modeling of: (1) non-conventional PV conversion processes based on quantum confinement and nanostructured concepts, intermediate-band solar cells, multiple charge generation, up/down converters, thermophotovoltaics, hot-carrier cells, and other concepts; (2) quantum dots, nanowires, and quantum wells, highly metamorphic materials, new materials systems; and (3) cross-cutting science and hybrid materials that include organic/inorganic materials and innovative devices such as luminescent concentrators.

## **Area 2: CIGS and CdTe Thin Film Solar Cells and Related Materials**

**Chair:** *Rommel Noufi, National Renewable Energy Laboratory, Golden, Colorado, USA*

**Co-Chairs:** *Tokio Nakada, Aoyama Gakuin University, Japan*

*Hans-Werner Schock, Helmholtz-Zentrum Berlin, Germany*

*Ayodhya N. Tiwari, EMPA, Swiss Federal Laboratory, Switzerland*

*Jim Sites, Colorado State University, USA*

- Subarea 2.1 Thin Film Deposition and Characterization of Absorber and Related Wide Band Gap and Novel Materials
- Subarea 2.2 Transparent Conductors, Buffer Layers, and Back Contacts
- Subarea 2.3 Device Properties and Modeling/Characterization
- Subarea 2.4 Advanced Processes and Controls: Atmospheric and Vacuum
- Subarea 2.5 Modules and Manufacturing: Process Controls, Performance, Interconnect, and Reliability

As the CdTe and CIGS technologies move from the lab to the factory, we encourage contributions addressing recent advances in manufacturing processes utilizing vacuum and/or atmospheric conditions, process controls and diagnostics, alternative buffers, TCOs, novel contacts, moisture barriers and other measures related to stability/reliability of the solar cell. To maintain a strong and broad science foundation for these two thin film technologies, we solicit contributions on the science and engineering of thin-film deposition, characterization of structural, optical and electrical properties, modeling, and the role of electrically active defects and impurities. Looking forward, we also solicit contributions exploring new materials, wide band gap absorbers, novel device structures, and tandem cells.

### **Area 3: III-V and Concentrator Technologies**

**Chair:** Frank Dimroth, *Fraunhofer ISE, Freiburg, Germany*

**Co-Chair:** Sarah Kurtz, *National Renewable Energy Laboratory, Golden, Colorado, USA*

**Co-Chair:** Kenji Araki, *Daido Steel, Japan*

- Subarea 3.1 III-V Epitaxy, Materials, Processing and Devices; III-V Concentrator Solar Cells
- Subarea 3.2 High Concentration PV Modules, Optics and Receivers
- Subarea 3.3 High Concentration PV Systems and Power Plants
- Subarea 3.4 Low concentration PV - Si Concentrator Cells, Modules and Systems

The highest conversion efficiencies of >40 % are obtained with multijunction solar cells made of III-V compound semiconductors. Materials science is the basis for the continuous improvements in the understanding and further development of these complex solar cell structures. We therefore call for papers on the materials science and technology in this field. This may include (but not be limited to) work on theoretical device modeling, epitaxy, solar cell processing and characterization. III-V multijunction solar cells are the basis for the growing terrestrial market of high concentration photovoltaics. At the same time, lower concentration approaches using silicon solar cells are gaining attention. At this conference we are encouraging submission of papers in all fields related to the materials science and technology of Si and III-V concentrator solar cells, receivers and systems. Manufacturing aspects, product reliability and testing are important aspects to be discussed for both solar cells and concentrator systems. Papers on the development of new concentrators including optics for high- as well as low-concentration are welcome. Further topics may focus on: tracker development, thermal hybrid systems, annual power rating, industry standards, CPV market development, cost reduction or ecological impact. Contributions may range from exploratory research through applied research, technology development, and engineering improvements.

### **Area 4: Crystalline Silicon Technologies**

**Chair:** Klaus Weber, *Australian National Univ., Canberra, Australia*

**Co-Chair:** Stefan Glunz, *Fraunhofer ISE, Freiburg, Germany*

**Co-Chair:** Stuart Bowden, *Arizona State University, USA*

- Subarea 4.1 Feedstock and Crystallization
- Subarea 4.2 Defect Passivation and Advanced Optics
- Subarea 4.3 Device Fabrication
- Subarea 4.4 Modeling, Metrology, and Characterization
- Subarea 4.5 Manufacturing

The continuing drive for higher conversion efficiencies and lower costs of crystalline Si cells demands an increasingly sophisticated understanding of the materials and processes involved, in order to drive the development of new or improved manufacturing methods, materials and device structures. Papers reporting on all aspects of c-Si technology are welcomed, including but not limited to: feedstock materials and crystal growth; defect characterization and passivation; advanced optics for light trapping and reflection control; new cell designs; device modelling; advanced measurement techniques; and solutions for large scale manufacturing.

## **Area 5: Amorphous, Nano, and Film Si Technologies**

**Chair:** Arno Smets, *Eindhoven Univ. of Technology, The Netherlands*

**Co-Chair:** Sumit Argarwal, *Colorado School of Mines, USA*

**Co-Chair:** Takuya Matsui, *National Institute of Advanced Industrial Science and Technology, Japan*

- Subarea 5.1 Fundamental Properties of Thin Silicon Films
- Subarea 5.2 Processing Issues for Thin Silicon Films and Devices
- Subarea 5.3 Novel Concepts for Thin Silicon Solar Cell Devices
- Subarea 5.4 Amorphous, Nano/Microcrystalline and Silicon Film Devices and Modules

Thin-film photovoltaics based on amorphous, nano/microcrystalline and polycrystalline silicon on non Si-substrates have matured through three decades of advances in the design and processing of high-quality materials, solar cells and modules. Detailed research studies and visionary papers addressing the entire spectrum of the subject are welcomed, including material characterization concerning microstructure, light induced degradation, SiGe alloys, film oxidation; processing issues concerning large throughput, large area, high deposition rates, processing routes for polycrystalline silicon; novel concepts for thin silicon solar cells concerning films with new functionalities, light trapping using plasmonic films, texturing, multi-layers and intermediate reflective layer; and all topics related to amorphous/microcrystalline and silicon film solar cells and modules such as multijunction structures, performance and long-term reliability.

## **Area 6: Organic Photovoltaics**

**Chair:** David Ginley, *National Renewable Energy Laboratory, Golden, Colorado, USA*

**Co-Chair:** Jan Kroon, *ECN, The Netherlands*

**Co-Chair:** Gitti Frey, *Technion, Israel*

- Subarea 6.1 Polymer and Small Molecule Based Organic Photovoltaics
- Subarea 6.2 Stability, Processing, and Packaging for Organic Photovoltaics
- Subarea 6.3 Tandem, QD Enhanced, and Advanced Concept Organic Solar Cells
- Subarea 6.4 Hybrid and Dye Sensitized Solar Cells
- Subarea 6.5 Mechanisms, Interfaces, and Models in Excitonic Solar Cells

Organic, hybrid inorganic/organic, and dye sensitized solar cells are rapidly advancing technologies that are beginning to demonstrate commercial viability. The flexibility of different donor/acceptor combinations including both organic small molecule and polymer as well as nanostructured inorganic materials stimulate a large diversity of approaches to the promise of more stable and efficient devices. Many of the devices are excitonic in nature necessitating new device modeling and all of them are dominated by interfaces between very heterogeneous materials with different structural, thermal and chemical properties. The symposium will focus on the examination of many of the key areas evolving in this diverse approach to solar energy. This includes papers in the broad spectrum of areas including: an exploration of the evolving devices and materials based on polymers, small molecules, and dyes, the potential enhancement of these devices with tandem or QD structures, the stability and packaging of organic based devices, and an examination of new models and data for the performance of excitonic and dye based devices and their complex interfaces.

## **Area 7: Space Technologies**

**Chair:** Alex Howard, *AFRL, Kirtland Air Force Base, Albuquerque, NM*

**Co-Chair:** Mitsuru Imaizumi, *JAXA, Japan*

**Co-Chair:** Carsten Baur, *ESA*

- Subarea 7.1 Space Materials and Devices
- Subarea 7.2 Space Systems
- Subarea 7.3 Flight Performance and Environmental Effects

Topics of interest are solar cells suited for space use, especially devices capable of high efficiency or high specific power, including solar array designs. The scope includes III-V, thin-film, and novel solar cells. Also of interest are papers concerning space reliability, space environmental effects, and protective materials for the space environment. We welcome papers concerning characterization and qualification of space solar cells and papers concerning flight experiments and missions.

## **Area 8: Advances in Characterization of Photovoltaics**

**Chair:** Angus Rockett, *Univ. of Illinois, Urbana-Champaign, USA*

**Co-Chairs:** Gerald Siefer, *Fraunhofer ISE, Freiburg, Germany*

Manuel Romero, *National Renewable Energy Laboratory, Golden, Colorado, USA*

Ayodhya Tiwari, *EMPA, Swiss Federal Laboratory, Switzerland*

Yoshihiro Hishikawa, *Advanced Industrial Science and Technology (AIST), Tsukuba, Japan*

Thorsten Trupke, *BT Imaging Pty Ltd, Surry Hills, Australia*

- Subarea 8.1 New Characterization Methods for PV: Optoelectronic, Physical, Chemical
- Subarea 8.2 Methods for Characterization of Defects
- Subarea 8.3 PV Cell and Module Measurement Techniques
- Subarea 8.4 In-situ Characterization Methods
- Subarea 8.5 Process Control and Modeling
- Subarea 8.6 Methods for Reliability Testing and Standards

The focus of Area 8 is to present works primarily focused on methods of characterization of photovoltaic materials and devices as distinct from focusing on the materials and devices characterized. Thus papers submitted to this area could range from new scanning probe methods to determine semiconductor properties to methods to calibrate an accelerated lifetime testing apparatus. In-situ characterization methods and process control methods are appropriate to Area 8 because they are about implementing a method in a given environment. Papers describing the performance or properties of specific materials and devices, if focused primarily on those materials and devices should go to the areas concerned with the relevant technology. However, a paper describing the application of a technique to a material, focused primarily on demonstrating the capabilities of a technique, belong in Area 8. Thus, a paper describing cathodoluminescence (CL) of CuInSe<sub>2</sub> would belong in Area 2 if focused on the CIS but in Area 8 if focused on how to conduct CL or the capabilities of a CL instrument. Exciting new work is being reported in this area ranging from novel methods of photoemission to advanced imaging and characterization methods for individual Si wafers through full modules.

## **Area 9: PV Modules and Terrestrial Systems**

**Chair:** *Angèle Reinders, University of Twente, Enschede, The Netherlands*

**Co-Chair:** *Terry Jester, Hudson Clean Energy Partners, USA*

**Co-Chair:** *Pierre Verlinden, Solar Systems, Australia*

- Subarea 9.1 Markets and Customers
- Subarea 9.2 PV Module Materials, Encapsulation and Manufacturing
- Subarea 9.3 Inverters and other BOS Components
- Subarea 9.4 Grid Connected Systems and Building Integration
- Subarea 9.5 Stand Alone Applications

PV modules are a vital commodity in the market of PV systems. We encourage submissions in all subjects associated with PV module materials, manufacturing and the performance of PV modules. Also papers reporting on markets and costs, and regarding the energy yield of PV modules are encouraged. Power conditioning equipment affects the reliability and efficiency of PV systems. Therefore, contributions describing technical issues and standardization of inverters and Balance-of-Systems (BOS) components are encouraged. Papers about design engineering, monitoring and control of very large scale grid-connected PV installations are welcome, as well as papers about incentives for, and experiences with residential grid-connected systems and building-integrated PV systems. The growing need for autonomous electricity supply is advancing the development of stand-alone PV solutions. We welcome contributions describing sizing and simulation of system integrated PV systems in the context of functionality, regulations, costs and environmental aspects. In Area 9 contributions can range from applied research and technology development, to papers about design, engineering, markets and user studies.

## **Area 10: PV Velocity Forum: Accelerating the PV Economy**

**Chair:** *John Benner, National Renewable Energy Laboratory, Golden, Colorado*

**Co-Chair:** *B. J. Stanbery, HelioVolt Corp., Austin, Texas, USA*

- Subarea 10.1 PV Programs, Policies and Incentives
- Subarea 10.2 PV Markets
- Subarea 10.3 Sustainability and Environmental Issues

The PV Velocity Forum brings technologist, investors and policy-makers together to explore methods for driving more cost-effective emerging technologies through production and into the market. Speakers and panelists will engage with attendees to explore gating factors affecting the adoption of new PV technologies, such as research support, policy development, regulations, supply chain, environmental issues and market-based project management. The Forum will address strategies to sustain or accelerate the high growth rate and drive costs down faster.

### **GENERAL CHAIR**

**Robert J. Walters**  
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### **PROGRAM CHAIR**

**Richard R. King**  
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## WILLIAM R. CHERRY AWARD

This award is named in honor of William R. Cherry, a founder of the photovoltaic community. In the 1950's, he was instrumental in establishing solar cells as the ideal power source for space satellites and for recognizing, advocating, and nurturing the use of photovoltaic systems for terrestrial applications. The William R. Cherry award was instituted in 1980, shortly after his death. The purpose of the award is to recognize engineers and scientists who devote a part of their professional life to the advancement of the technology of photovoltaic energy conversion. The nominee must have made significant contributions to the science and/or technology of PV energy conversion, with dissemination by substantial publications and presentations. Professional society activities, promotional and/or organizational efforts and achievements are not considerations in the election for the award.

This award is presented at each IEEE Photovoltaic Specialists Conference. The recipient is selected by the William R Cherry Committee composed of past PVSC conference chairpersons and past recipients of the award. Those nominated for the award do not participate in the process.

To be eligible for the award, the nominee must currently be active in the science and technology of PV conversion. He/she must have been active in the field for an extended period, with expectation of continued activity. Short term activities in the field, and/or single outstanding contributions are not adequate to make a person eligible for the award.

To make a nomination, please submit:

1. The name of your nominee, and his/her current affiliation.
2. A summary (less than 100 words) of the nominee's contributions to the advancement of the PV field.
3. A citation (less than 40 words) listing the nominee's specific contributions to make them deserving of the award.
4. A list of the nominee's activities in the field.
5. Nominator's name, address, phone number and e-mail address.

Please send any nominations for the next William R. Cherry award (35<sup>th</sup> IEEE PVSC) to:

Dr. Antonio Luque, Instituto de Energia Solar  
Universidad Politecnica de Madrid  
E28040 Madrid, SPAIN  
Tel: +34 91 544 1060, Fax: +34 91544 6341  
E-mail: Luque@ies-def.upm.es

**The deadline for Cherry Award nominations to be considered for the 35<sup>th</sup> IEEE PVSC is  
December 31, 2009.**

**Previous recipients of the William R. Cherry Award:**

|                                  |             |                                   |             |
|----------------------------------|-------------|-----------------------------------|-------------|
| <b>Dr. Paul Rappaport</b>        | <b>1980</b> | <b>Dr. Adolf Goetzberger</b>      | <b>1997</b> |
| <b>Dr. Joseph L. Loferski</b>    | <b>1981</b> | <b>Dr. Richard J. Schwartz</b>    | <b>1998</b> |
| <b>Prof. Martin Wolf</b>         | <b>1982</b> | <b>Dr. Christopher R. Wronski</b> | <b>2000</b> |
| <b>Dr. Henry W. Brandhorst</b>   | <b>1984</b> | <b>Dr. Richard M. Swanson</b>     | <b>2002</b> |
| <b>Mr. Eugene L. Ralph</b>       | <b>1985</b> | <b>Dr. Ajeet Rohatgi</b>          | <b>2003</b> |
| <b>Dr. Charles E. Backus</b>     | <b>1987</b> | <b>Dr. Timothy J. Coutts</b>      | <b>2005</b> |
| <b>Dr. David E. Carlson</b>      | <b>1988</b> | <b>Dr. Antonio Luque</b>          | <b>2006</b> |
| <b>Dr. Martin A. Green</b>       | <b>1990</b> | <b>Dr. Masafumi Yamaguchi</b>     | <b>2008</b> |
| <b>Mr. Peter A. Iles</b>         | <b>1991</b> | <b>Dr. Stuart Wenham</b>          | <b>2009</b> |
| <b>Dr. Lawrence L. Kazmerski</b> | <b>1993</b> |                                   |             |
| <b>Prof. Yoshihiro Hamakawa</b>  | <b>1994</b> |                                   |             |
| <b>Dr. Allen M. Barnett</b>      | <b>1996</b> |                                   |             |