

## In Memoriam

**JÜRGEN OTTO BESENHARD** passed away on November 4, 2006 in Graz, Austria. He is survived by his children, sons Maximilian (20), Sebastian (19), Florian (15), and a daughter Hanni (11). Professor Besenhard was born in Regensburg (Bavaria, Germany) on May 15, 1944. He remained a dedicated Bavarian throughout his life. His education took place in the cities of Regensburg and Augsburg. He began his chemistry studies at the Munich University of Technology, where he received his doctorate in 1973. His work was devoted to non-aqueous electrolyte chemistry in lithium batteries. During this time, and as reader and lecturer (1973-1986) in Munich, he became more and more involved in the field of primary and rechargeable lithium batteries. It is clear that he was one of the fathers of lithium and lithium-ion battery chemistry as we know it today. There were numerous exploratory research findings on lithium batteries in the late '60s and early/mid '70s, through which Prof. Besenhard brought in the interpretation and understanding of the complex phenomena involved. This is especially evident in his early works such as: the understanding of reversible alkali metal ion intercalation into graphite (anodes);<sup>1</sup> the understanding of reversible alkali metal ion insertion into oxide materials (cathodes);<sup>2</sup> the first reviews on lithium batteries;<sup>3</sup> and the preparation of lithium alloys with defined stoichiometry in organic electrolytes at ambient temperature.<sup>4</sup> Historically, these pioneering works have been very important for the progress of the lithium battery technology, which has become a dominant field in applied electrochemistry since then.

After a postdoctoral fellowship with Roger Parsons at the University of Bristol (UK) in 1977, he received a full professor position at the University of Muenster (Germany) in 1986. At Muenster he expanded his activities to countless topics in the field of applied electrochemistry: electrodeposition, electroless plating, microelectrodes and microelectrode arrays, metallization of plastics, carbon chemistry, intercalation chemistry, composite electrodes, fuel cells, membranes, organic synthesis, electro-fluorination, supercapacitors,



**Jürgen O. Besenhard**  
1944-2006

coating, aqueous batteries, etc., while continuing his remarkable contributions to the Li battery field. In 1992, he was the chair of the 6<sup>th</sup> International Meeting on Lithium Batteries in Muenster, an unforgettable conference for all attendees.

In 1993, Prof. Besenhard assumed the position of head of the Institute of Chemistry and Technology at Graz University of Technology in Austria, an institute well-known for its breakthrough research in batteries and fuel cells. At Graz, his work emphasized the development of an understanding of the electrolyte additives and their effect on lithium electrode operation, nanostructured rechargeable alloy anodes, carbon surface modification and new dip-coating processes for electrode fabrication for lithium-ion batteries. There were many more activities, however, because of the strong connections of his work to industry. In this regard, most of the later lithium battery related research at Graz was proprietary and could not be published. In general, seeing the application of his work in commercial products was a leading motivation during his scientific career.

In Austria, he became the leading authority in the field of electrochemistry. He was chair of the special research program, "Electroactive Materials," chair of the advisory board of the Applied Electrochemistry Center of Competence Kplus EChem,

member of the Christian Doppler Senate in Vienna, and he was the recipient of the Loschmidt Medal of the Austrian Chemical Society in 2002. Internationally, he received high recognition and was awarded the Hawaii Battery Award for "groundbreaking work on the negative electrode of lithium ion batteries" in 2000 and the Yeager Award of the International Battery Material Association (IBA) for "outstanding and pioneering work on anodes for lithium batteries" in 2001. He organized the 2004 IBA meeting in Graz, and became president of the IBA in 2006. Scientifically, his efforts were still strongly devoted on the lithium battery topic.

Prof. Besenhard had more than 800 publications, including over 50 patents. He was the editor of the well-known *Handbook of Battery Materials*. He also was a member of the editorial boards of: *Journal of Solid State Electrochemistry*, *ITE Letters on Batteries*, *New Technology and Medicine*, *Ionic*, and the *International Journal of Electrochemical Science*. During his career, Prof. Besenhard was the mentor and supervisor of more than 100 diploma and doctoral students. He was a visiting professor at the Shanghai Institute of Microsystems and Information Technology for Energy Science (China). Prof. Besenhard was a highly respected teacher inside and outside the university. He also was an invaluable adviser to the young colleagues in the lithium battery field based on his extensive knowledge garnered during his scientific work.

Prof. Jürgen Besenhard was an exceptional and devoted scientist and he leaves behind an enduring record of achievements. His work assures him a highly prominent position in the history of battery technology. Two days before his passing away, he was attending the joint international meeting of ECS and other societies, held in Cancun, Mexico. All who have worked with Prof. Besenhard and who had the privilege to be his colleague and friend will always remember a kind and gentle personality, a man with unique humor and charisma. The scientific community and especially the lithium battery community will miss him.

## References

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*This notice was prepared by Martin Winter (on behalf of the Institute of Chemistry and Technology of Inorganic Materials at Graz University of Technology) with the help of Prof. Besenhard's family.*

## In Memoriam

**ERHARD SIRTL** was a key scientist in the early development of the characterization of silicon materials and chemical vapor deposition (CVD) of silicon, in particular for epitaxial films. In the second part of his professional career he managed ambitious programs for the low-cost fabrication of silicon materials for photovoltaic applications.<sup>1</sup>

Erhard Sirtl was born in Munich, Germany (well-known for its "Octoberfest") in 1928. He studied chemistry at the University of Regensburg from 1948 to 1955 and at the Technical University of Munich where he received a PhD in chemistry. He joined the Research Laboratories of Siemens & Halske AG in Munich in 1955 where he carried out research on semiconductor materials characterization and on the epitaxial deposition of semiconductor films. In this period he invented the subsequently famous "Sirtl Etch." The etchant named after him was a real-time, useful diagnostic technique (for the (111) orientation) which indicated the presence of dislocations in the grown crystalline silicon ingot, the chemically etched and polished silicon wafer; and the wafer after subsequent device/integrated circuit (IC) fabrication. The extent of these analyses were especially important in the characterization of (111) oriented silicon wafers utilized for bipolar ICs throughout the 1960s and 1970s.

Erhard Sirtl cultivated a close scientific relationship with Eberhard Spenke in those days. Spenke, the author of *Electronic Semiconductors*, one of the first, and finest, books written about the fundamental physics of semiconductor devices,



**Erhard Sirtl**  
1928-2006

was Director of the Siemens & Schuckert Pretzfeld-Laboratory where the polysilicon deposition process via trichlorosilane ("C-Process" or "Siemens-Process") and the floating-zone crystal growth technique for power device applications were developed. Spenke also delivered, in 1969, the first lecture in the first International Symposium on Silicon Materials Science and Technology.<sup>2</sup>

Erhard Sirtl moved to the U.S. in 1969 to Dow Corning Corporation in Midland and then to Hemlock, Michigan. He was appointed Director of the Solid State R&D Department and managed programs on high-purity and low-defect density silicon crystal growth (floating zone, Czochralski, and electron beam pedestal grown crystals of typical

2" diameter). Among the members of his group were John Baker, who provided the experimental data for the calibration factor of oxygen in Czochralski silicon published in the original ASTM procedure; and Ted Ciszek, well known as an expert on crystal growth and defect characterization, who later on joined the group of Guenther Schwuttke at IBM and then SERI (Solar Research Institute). Ted Ciszek's paper,<sup>3</sup> presented in 1973 at the Second Silicon Symposium, describes some of the R&D work of that period. During this time Erhard also promoted the development of a defect etching solution for (100) oriented silicon wafers by his coworker Secco d'Aragona, which is now the most widely used etchant for defect delineation on (100) wafers. During this time at Dow Corning Erhard still corresponded frequently with Spenke and visited his group (in Munich then) several times discussing aspects of swirl defects, striations and impurities (oxygen and carbon) in silicon, their formation and techniques for their characterization and determination.

Erhard returned to Germany in 1972 and, in 1974, became Director of R&D of Wacker-Chemitronic in Burghausen, Bavaria where he was in charge of crystal growth development for large-diameter silicon (100 mm diameter and larger), compound semiconductors, and sapphire. The development of dislocation-free Czochralski silicon crystal growth required not only adjustments in the processes utilized for fabrication of devices and ICs, but accentuated

*(continued on next page)*

the importance of point defects and what Erhard Sirtl (and several other independent personnel) identified as the importance of "defect engineering." That is, the concept of overcoming "certain limitations in as-grown, dislocation-free crystals in terms of inhomogeneities of both intrinsic and extrinsic nature."<sup>1</sup> Several of these inhomogeneities included structures referred to as "saucer pits," "striations," and process-induced oxidation stacking faults (OSF). In a related fashion early on, Erhard, was quite cognizant of the implications of the evolving importance of larger-diameter silicon crystal growth and the implications for the cost structure of the industry.

When, as a consequence of the first oil crisis in 1973, R&D on alternative energies was pushed worldwide, in Germany Wacker-Chemitronic concentrated its activities on the development of novel fabrication processes for low-cost solar-grade silicon in the newly founded daughter company *Heliotronic*. Erhard became its Technical Director, developing novel processes for casting of large-grain polycrystalline silicon blocks ("SILSO") and multiple wire sawing of those blocks into thin sheets for the large-scale fabrication of silicon solar-cell devices. Based on this successful pioneering work for solar material, wire sawing technology was subsequently used for the cost-effective cutting of state-of-the-art large diameter silicon ingots, including 300 mm, diameter silicon ingots for microelectronics.

Erhard Sirtl's scientific activities resulted in 55 publications in renowned scientific journals and 70 German and U.S. patents. Among his publications are a number of important research articles in the *Journal of The Electrochemical Society*. Erhard was very active in the ECS Electronics and Photonics Division in its early days (member since 1969). He was also the co-chair and co-editor with one of us (HRH) for

the *Third International Symposium on Silicon Materials Science and Technology in 1977*. He also served as co-chair and co-editor of the symposium and proceedings volume, *Materials and New Processing Technologies for Photovoltaics* with J. A. Amick, P. Rai-Choudhury, and J.P. Dismukes in 1981. As a member of the board of the Electronics and Photonics Division and its Committee for European Affairs, he initiated the first satellite symposium to ESSDERC (European Solid State Device Research Conference) in Munich 1982 on "Aggregation Phenomena of Point Defects in Silicon" (E. Sirtl, J. Goorissen, and P. Wagner, Editors). This was continued by one of us (BOK) with a series of symposia entitled ALTECH (Analytical and Diagnostic Techniques for Semiconductor Materials, Devices, and Processes) and DECON (Crystalline Defects and Contamination: Their Impact and Control in Device Manufacturing). Further European activities of Erhard Sirtl included "Workshops on Solar-Grade Silicon" in 1984 and 1987, and an E-MRS Summer School on "Current Problems of Semiconductor Surfaces and Interfaces" with Herbert Jacob in 1986. Together with Hans Queisser and Herrmann Grimmeiss, he also founded the "Punktdefektetreffen" (Workshop on Point Defects) at the end of the '70s, a meeting which has since taken place more than 40 times.

Erhard Sirtl received a number of awards and honors including the ECS Electronics and Photonics Division Award in 1979, the Dechema-Preis (Award) of the Max-Buchner-Research Foundation in 1982, and an honorary degree (PhD h.c. (honoris causa) from Montan-University, Leoben, Austria in 1986. He was appointed apl. (extraordinary) Professor at the University of Munich in 1979. He also served as chair or member of several scientific advisory boards in Germany. In order to impart his

scientific expertise and experience to students, Erhard acted as a lecturer at the University of Munich and at the University of Michigan, Ann Arbor (USA).

Erhard Sirtl was a congenial colleague and for one of us (BOK), a most stimulating and promoting paternal friend. Perhaps most importantly, Erhard graciously shared his extensive understanding of the interactive influence of silicon materials and the fabrication (and characteristics) of the resulting devices and ICs with the global scientific community.

In his limited spare time, Erhard Sirtl was an enthusiastic collector of minerals and stamps, a talented painter as well as an aquarellist.

## References

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*This notice was written by Bernd O. Kolbesen and Howard R. Huff, who are grateful to the family of Erhard Sirtl for supplying a significant portion of the material about his scientific and private activities.*

## In Memoriam

**GIOVANNI BATTISTON** (1947-2006), member since 1997, High Temperature Materials

**JACK T. BROWN** (1930-2006), member since 1992, Battery

**ROLAND DAPO** (1933-2006), member since 1967, Dielectric Science and Technology

**THEDFORD P. DIRKSE** (1915-2006), member since 1943, 1962 Battery Division Research Award recipient

**H. DALE HANNAN** (1919-2006), member since 1968, Battery

**VOLKER LEHMANN** (1956-2006), member since 1994, Electronics and Photonics

**ROBERT M. MURPHY** (1942-2006), member since 1978, Battery

**STEPHEN P. WHITE** (1950-2006), member since 2005, Corrosion

## In Memoriam



**Thomas C. O'Nan**  
1921-2006

**THOMAS C. O'NAN** passed away September 29, 2006. Mr. O'Nan was employed by P. R. Mallory/Duracell as an electrochemist in the research and development division for 43 years. He is survived by a brother, James O'Nan; four nephews; two nieces; and numerous great nieces and nephews. He was preceded in death by his wife, Shirley O'Nan.

Mr. O'Nan was a 1941 graduate of Butler University (Indianapolis). He joined Mallory Bearing in 1941, starting as a Junior Engineer and eventually became Section Chief, responsible for product engineering and improvement. During 1946 and 1947, he was assigned to technical development in the Materials Laboratory of Wright-Patterson Air Force Base in Dayton, Ohio, and was involved in the innovation of new techniques for electrolytic co-deposition of Pb/In alloys.

From 1947 to 1960, O'Nan worked for Mallory Corporate Research and was responsible for low-temperature alkaline system battery development, mercury cell development, and other Mallory product areas such as capacitors and semiconductors. In 1961, he became Section Chief of Product Development for Mallory Capacitor and served as a technical consultant to a program that explored the Ruben process for the electrolytic perforation of stainless steel sheets. For Mallory Battery (1970-1979), he served as Vice President of Engineering and oversaw the technical aspects of Mallory's pacemaker battery activities, among other duties. From 1980 to 1984, he was Manager of Technical Services for

Mallory Battery/Duracell, Inc., and was responsible for the organization of testing facilities, design and organization of reporting systems, and supervised government-associated activities. In 1985, he returned to managing product development, with supervision of a high-temperature aqueous battery project. In 1986, he was named a Senior Staff Engineer at Duracell; and he completed his long career as an independent technical consultant, until 1999 when he finally retired and moved back to Indianapolis from Baltimore.

Mr. O'Nan held several battery patents through P. R. Mallory/Duracell. He helped organize the former Indianapolis Section, served as its Secretary-Treasurer, Vice-Chair, and Chair. He was the Finance Chair of the spring ECS meeting in Indianapolis in 1961. Mr. O'Nan had been a member of ECS since 1945.

*Thanks to Dr. O'Nan's namesake and nephew, Thomas R. O'Nan, for helping with this notice.*

## Future Technical Meetings

**Oct. 7-12, 2007**  
Washington, DC

**May 18-23, 2008**  
Phoenix, Arizona

**Oct. 12-17, 2008**  
**PRIME 2008**  
Honolulu, Hawaii

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