In Memoriam

Jefferson C. Cole (1915-2006)

Jefferson C. Cole, ECS member since 1955, died May 4, 2006 after a short illness in Columbus, Ohio. Mr. Cole was employed by Diamond Alkali and subsidiary companies for 36 years, retiring from the Electrode Corporation (now ELTECH Gruppo de Nora) in 1976. For the next ten years he maintained his own chemical engineering consulting prac-tice. He witnessed first-hand the evolution of the chlor alkali industry from graphite anodes to dimensionally stable electrodes, from mercury cells and diaphragm cells to modern day membrane electrolyzers.

He told the story that Prof. Vittorio de Nora once said that Jeff was the first employee of Diamond Alkali he had ever met (circa 1950). The meeting, in St. Louis, MO, was arranged to discuss the supply of mercury cells engineered by Oronzio de Nora, Milan, Italy for a Diamond Alkali facility located in Muscle Shoals, AL. His initial encounter with Prof. de Nora blossomed into a life-long technological revolution that completely changed the way chlor alkali is made today.

Jeff graduated from The Ohio State University in 1938 with a bachelor's degree in chemical engineering. He was a 50-year member of ECS and was awarded the Society's 69th Honorary Membership in 2001. He was active in the Industrial Electrolytic Division (today's Industrial Electrochemistry & Electrochemical Engineering Division) and served as chair and liaison to Vittorio de Nora regarding the administration of the Society's Vittorio de Nora Award. He attended as many ECS meetings as he could, including 41 meetings together with his wife, Audrey, who passed away in 2001. Being a pilot, Jeff and Audrey occasionally flew to a meeting venue in his favorite Cessna 172. V. H. "Bud" Branneky, former Executive Secretary of ECS, said that Jeff Cole will be remembered as the "gentle" gentleman. Fumio Hine, Professor Emeritus, Nagoya Institute of Technology (Japan) recalls a fifty-year relationship with Jeff both as a colleague and a very good friend within ECS.

Jeff lived in the home that he designed and built in 1951 in Painesville, OH. He was an active member of the United Methodist Church of Painesville and an associate member of the Lake County Retired Teachers Association. He enjoyed playing golf, traveling to all 50 states and 41 foreign countries with his wife and participating in activities at his alma mater, The Ohio State University.

He is survived by his sons, Ronald W. (and wife Jo Ann) of Pickerington, OH and Richard J. (and wife Dee Dee) of Stow, OH; three grandchildren and two great-grandsons.

Ed. Note: Thanks to Dennie T. Mah, immediate past chair of the IE&EE Division for providing this notice.

S. K.Rangarajan (1932-2008)

On April 29, 2008, the Indian scientific community, especially the electrochemical community, lost one of its jewels in the passing away of **S. K. Rangarajan**, affectionately monikered "SKR" by his Indian colleagues and "Ranga" by others.

Professor S. K. Rangarajan, born September 9, 1932, obtained his BA (Hons.) from the Madras Christian College, Madras in 1953. He worked as an assistant lecturer at the Madras Christian College for two years, then as an assistant professor at the A.C. College of Engineering & Technology of Madras University (1957-60), and later joined the Central Electrochemical Research Institute (CECRI) in Karaikudi. As a Homi Bhabha Fellow, he worked at the National Aeronautical Laboratory in Bangalore from 1970-75. He served as a professor at the Indian Institute of Science (IISc) in Bangalore from 1975 to 1993. During the last three years there, he also served as Director of CECRI. After a brief stint as a senior professor at the Institute of Mathematical Sciences, Madras, he served at the Raman Research Institute in Bangalore as Professor Emeritus.

Professor Rangarajan was a mathematician by training and a physical chemist by practice. His contribution to electrochemistry was the infusion of mathematical rigor to understand and define the fundamental, molecular aspects involved in charge transfer at interfaces and adsorption. His mathematical "gray matter" allowed him to analyze problems clearly without bias and preconceived notions. His contributions were ahead of his times and his writings were esoteric.

He is revered, especially in India, for his role as a teacher and motivator *par excellence*. He gave unfettered, intellectual support toward fostering electrochemistry in India by trying to enthuse the younger generation through stimulating discussions, teaching courses, and organizing scientific meetings. He is survived by his wife, four sons, and a daughter. His legacy will endure.

Ed. Note: This notice was prepared by Tilak Bommaraju, PTO, Inc. (Grand Island, NY, S. Sarangapani, ICET, Inc. (Norwood MA), and Ashok Shukla, CECRI (Karaikudi, India) and Associate Editor of the Journal of The Electrochemical Society.

In Memoriam

Howard J. Strauss (1920-2008), member since 1947, Battery.

James Patrick Hoare (1921-2008), member since 1955, Electrodeposition.

Shin-Ichiro Takasu (1928-2007)

It is with profound sadness that I am called upon to write a few thoughts about my late colleague and friend **Shin-Ichiro Takasu**. Takasu-san will strongly be remembered: for his qualities as a colleague, his leadership scientific contributions to the success of the integrated circuit (IC) industry and, far from least, his warmth and soft sense of humor.

I immediately remembered a several hour technical discussion with Takasu-san at the fall 1976 ECS meeting in Las Vegas. This discussion occurred rather concurrently with the beginnings (1976-1979) of the Cooperative Laboratories of the Very Large Scale Integration (VLSI) Technical Research Association in Japan. Takasu played a key role in the Cooperative Laboratory as regards silicon crystal and wafer technology. His chapter on Crystal Technology in the Springer-Verlag book edited by Yasuo Tarui in 1986 (originally published in Japan in 1981) was significant to many of us working in the silicon materials and device process technology arena. That is, Takasu-san's grouping of crystal growth, conversion to a polished wafer, thermally induced micro-defects, gettering, and epitaxial growth as an integrated whole. Indeed, the field of wafer mechanics, in conjunction with the process-structure-property triad, was essential for enhancing IC performance, yield, and reliability. The triad relates the material process details of silicon crystal growth, conversion to a polished wafer, various configurations of silicon (or germanium, etc.) on insulator structures, epitaxial deposition, as appropriate as well as subsequent IC processing technology to the material structural configuration, which thereby uniquely establishes the material device properties.

The necessity, therefore, of appropriately designing a wafer for its application led Takasu-san to develop the concept of an engineered silicon wafer incorporating a series of engineered zones in the silicon wafer to ensure achieving the desired device and IC properties. Concurrently, Lawrence & Huff in America and Richter & colleagues in Europe were evolving the similar design engineered wafer concept. Surely, these were heady days as the IC industry was shrinking the globe, IC scaling methodologies were being widely implemented, and communication within the silicon materials community was significantly furthered.

This internationalization was additionally enhanced via the quadrennial Silicon Materials Science and Technology Symposia, sponsored by the ECS, from 1969 through 2006. Takasu-san played a major part in these symposia, authoring three papers on various aspects of crystal growth technology and serving as a session co-chair, over three decades from the 1970s through the 1990s. These international symposia were further augmented by the complementary timing of the quadrennial Japanese Conference on Advanced Science and Technology of Silicon Materials held in Hawaii and the biannual Gettering and Defect Engineering in Semiconductor Technology (GADEST) Conference, sponsored by our European colleagues. In that regard, a fifty-year retrospective of the ECS Electronics & Photonics Division,[1] written in celebration of the 100th anniversary of ECS in May 2002, presents (one view of) the improvements in silicon material technology accompanying the development of a design engineered silicon wafer. It surely seems to be a fortuitous coincidence that grouped both Takasu and Huff together in the same figure in this article.

With the shrinkage of global distances and enhanced communication during these times, the stage appeared appropriate for establishing a Roadmap for Semiconductor Technology. With the National Technology Roadmap for Semiconductors (NTRS) initiated by SEMATECH in the early 1990s, it was clear that we would quickly evolve to the International Technology Roadmap for Semiconductors (ITRS) wherein JEIDA, ASTM, and SEMI would play a cohesive role among the participants from the several continents. It was especially in this endeavor that Takasu-san brought forth and shared his integrated knowledge and insightful understanding of silicon materials technology for the benefit of the International Roadmap Community.

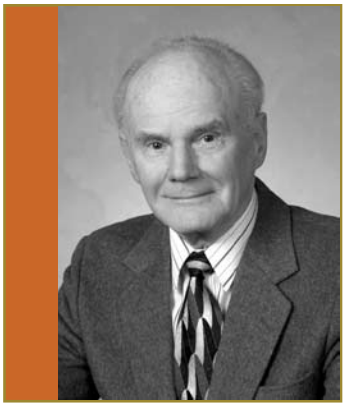
Beyond the above brief comments—noting that these comments are just as "thin in summary" as the thickness of the near-surface defect-free zone for IC fabrication (compared to the wafer thickness)—there was another significant side to Takasu-san that we have not yet noted. And that was Takasu-san's warmth and his sly unfolding and sharing of a picture, sample, or comment, which reflected a quite playful side cherished by all.

Well, Shin-ichiro Takasu is gone. But not the memory of Takasu-san's extensive knowledge, his sharing of insights with us and gentle wit.

Ed. Note: This notice was prepared by Howard Huff, SEMATECH Senior Fellow, Emeritus

1. H. R. Huff, "An Electronics Division Retrospective (1952-2002) and Future Opportunities in the Twenty-First Century," *J. Electrochem. Soc.*, **149**, S35 (2002).

Ákos G. Révész (1927-2008)



Ákos G. Révész, a recipient of the Thomas D. Callinan Award of the Dielectric Science and Technology Division, died March 22, 2008. He was well known for his many contributions to the science of silicon dioxide and silicon nitride chemistry and physics.

Dr. Révész received the Diploma of Engineering and PhD degrees in inorganic/physical chemistry from the Technical University of Budapest, Hungary, in 1950 and 1968. In 1950, he was with the Iron and Steel Research Institute, and from 1951 to 1956 he joined Tungsram Corporation where he started the company's semiconductor activities. He became the head of the Semiconductor Development Department in 1954 and was working on silicon point contact rectifiers, germanium p-n junction diodes, and thermistors, until he left Hungary in 1956. From 1957 to 1959, he was at the Philips Company in Eindhoven, Holland developing the solid-state $Ta/Ta_2O_5/MnO_2$ electrolytic capacitor. In 1959 he joined the RCA David Sarnoff Research Center in Princeton, NJ, where he was active in the pioneering work on the physics and chemistry of Si/SiO_2 interface structures and related semiconductor devices. He recognized the importance of the vitreous structure of SiO_2 films and the effects of hydrogen contamination on practically all their properties. He had also developed an in situ oxidation/annealing technique to minimize the H-contamination; this technique is now used in the cluster-tool technology.

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From 1969 to 1983 Dr. Révész was with COMSAT Laboratories outside Washington, DC, in various positions. There he continued to work on semiconductor/insulator interface structures, primarily as related to their irradiation behavior. He developed the vitreous Ta_2O_5 antireflection film for Si solar cells used in communications satellites, which played a key role in increasing their conversion efficiency by ~50%. He was also involved in realizing the essential role of Si-H bonds in amorphous SiH_x layers that until then were considered as amorphous silicon. He solved a serious reliability problem of Ge tunnel diodes that were essential in communications satellites at that time; as a result, these devices used in 15 satellites accumulated 2x106 device hours without any failure.

Since 1984, Dr. Révész had been working as an independent consultant primarily, but not exclusively, for the Naval Research Laboratory and Defense Nuclear Agency (renamed as Defense Threat Reduction Agency) on the fundamentals of the irradiation behavior of MOS and SOI structures, as well as on the role of Si nanoclusters in the buried oxide layer of SIMOX structures. In the course of this activity he collaborated with several entities, for example, Texas Instruments, Northrop Research Laboratory, Sandia Laboratories, etc.

Dr. Révész was an internationally known scientist, who worked throughout his adult life up to a few months before his death. He was a visiting professor at Howard University in Washington, DC (1984-1985), University of Leuven (1988 and 1989), and a visiting (guest) scientist at the Centre National des Etudes de Telecommunication, Grenoble (1986), Forschungszentrum Rossendorf, Dresden (2001 and 2002). He was the organizer and co-chair of the International Symposium on the Structure and Bonding in Non-Crystalline Solids, Reston, VA, 1983, as well as co-organizer and co-chair of the Conference on the Physics and Technology of Amorphous SiO_2, Les Arcs, France, 1987.

He received the David Sarnoff Outstanding Achievement Award in 1965. Dr. Révész was a 25 year member of ECS. In 2003, he received the prestigious Thomas D. Callinan Award of the ECS Dielectric Science and Technology Division. He wrote a chapter in the first book on MOSFET devices published in 1966 and was the co-editor of the Proceedings of the Symposium on the Structure and Bonding in Non-Crystalline Solids. He was the author or co-author of 130 papers and 15 conference presentations.

Dr. Révész lived in the Carderock Springs neighborhood of Bethesda, MD from 1969 until his death. He was a man of culture, erudition, and refinement who could converse comfortably in five languages. His discussions were never dull, and his judgments—once formed—were expressed with firmness and certitude. Dr. Révész enjoyed music, reading, and gardening, and was a wine and cheese connoisseur. He was an active member of the Hungarian Club of Washington, DC, the Carderock Springs Citizen Association, the Wagner Society of Washington, DC, the Goethe Institute, and the Appalachian Mountain Club. He is survived by his wife of 33 years, Kinga Révész, a scientist at the U.S. Geological Survey, and by two sons, Thomas and Paul, both of whom live in Washington, DC.