Irresistible Innovation

C. Grant Willson, the 2005 Frits Zernike Award for Microlithography recipient, speaks to *oemagazine* about his award-winning breakthrough and recent research at UT Austin.

C. Grant Willson, of the University of Texas at Austin, is this year's Frits Zernike Award for Microlithography recipient, primarily for his development of chemical amplification. This photochemical route to high sensitivity was able to produce resists with 1000 times greater sensitivity than conventional materials with no loss in resolution.

"The impact of Dr. Willson's work on chemically amplified resists is hard to overestimate," says SPIE member Chris Mack, KLA-Tencor (Austin, TX). "The ability to tailor high resolution with acceptable sensitivity at DUV [deep ultraviolet] wavelengths would not have been possible without this significant and novel innovation in resist chemistry. This is one of just a handful of absolutely essential technological breakthroughs in lithography over the last 20 years that has enabled the continuation of Moore's Law."

In 1978 Willson joined the IBM Almaden Research Center, where he reached the level of IBM fellow. In 1993 he began teaching in the Department of Chemistry and the Department of Chemical Engineering at the University of Texas at Austin. He has received two teaching awards since that time: the Semiconductor Research Corporation (SRC) Aristotle Award in 1999 and a Student Engineering Council Teacher Excellence Award in 2003, as well as numerous other awards including the American Chemical Society Carothers Award in 1992, the National Academy of Sciences Award for Chemistry in Service to Society in 1999, and six IBM Innovation Awards.

Willson was interviewed for *oemagazine* by Erin M. Schadt.

SPIE: Can you explain how and when you developed the method of chemical amplification to create high sensitivity resist materials?

CGW: The original work was done in the early 80s at the IBM San Jose Research Center. It was done in collaboration with Professor Jean Fréchet, now at the University of

C. Grant Willson

California, Berkeley, who was there on sabbatical leave, and Dr. Hiroshi Ito, who I had hired as a post-doctoral research fellow. Dr. Ito is still doing great work at IBM. We realized that the resolution advantages associated with moving from I-line to deep-UV lithography were accompanied by a huge reduction in productivity because the mercury discharge light sources available at that time had limited brightness in the deep UV. The only way to deal with this problem was to find a very much faster resist system or a very much brighter light bulb. We pursued both pathways.

The bright light bulb was the excimer laser, and Dr. Kanti Jain and I are co-inventors on the IBM patent claiming excimer lasers as light sources for lithography. Kanti designed and built the first excimer laser scanner tool at IBM. In the meantime, we explored the use of photogenerated catalysts as a means of increasing resist sensitivity. That work quickly led to the "Chemical Amplification" patents. The term was chosen as a means to communicate the concept of chemical catalysis to our higher management, who were largely electrical engineers who clearly understood the concept of amplification but were not as familiar with chemical catalysis.

SPIE: Do you think chemical amplification and the further advancement of polymer resists will continue to help engineers pursue Moore's Law, or will new technologies be needed as transistor density increases?

CGW: I believe that quite soon, we need to find a new family of resist materials because the chemical amplification scheme as currently practiced suffers from an intrinsic bias or blur that is the result of mass transport of the catalyst. This problem can be minimized, but so far only by greatly reducing the speed of the resists. Efficient manufacturing of feature sizes in the 20- to 30-nm regime and below may require a very different resist design or a printing technology that is radically different from that in use today.

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—C. Grant Willson

SPIE: Can you tell me about some of the research projects you are currently leading at UT Austin?

CGW: My group is working on a wide range of projects. We have been working toward the development of a fundamental, mesoscale simulator for lithography that can be used to explore the stochastic nature of the process and accurately simulate line-edge roughness and the effect on the final image of changes in, for example, polymer molecular weight, bake temperatures and times, etc., without having to rely on response parameters as we do now. SRC has been a great supporter of this interesting work.

We are also heavily involved in step and flash imprint lithography [SFIL]. We believe that this low-cost, high-resolution printing technology holds great promise for the future. Our current efforts are heavily focused on implementation of SFIL in the back end of the line, where it offers the potential for removing over 100 unit process steps from the metallization flow. We also have projects related to biosensor array technology in which we are exploiting lithographic techniques to fabricate biosensors in a new way.

We are heavily involved in a number of joint projects with SEMATECH under the auspices of the Texas Advanced Materials Research Center and are proud of our long and fruitful association with SEMATECH. The group continues to have a balance of fundamental and applied projects that exploit our ability to make new materials and study them in their end use.

SPIE: Can you tell me a little about your life outside work?

CGW: I have been heavily involved in racing sail boats and ocean racing yachts in the past, having participated five times in the Los Angeles to Honolulu Race, the Los Angeles to Tahiti Race, and many others.

SPIE: Is there anything else that you would like to add?

CGW: [That] I have the best students in the world . . . they are the very best at what they do.

@ For an extended version of this interview, visit oemagazine.com.

MEMBER NEWS AND ANNOUNCEMENTS |

Optical Metrology Symposium Highlight of Laser 2005

The SPIE International Symposium on Optical Metrology is the only conference in Europe to bring together scientists, engineers, researchers, and applications or product developers engaged in optical metrology and art conservation. The symposium will address the role of lasers in the following areas: optical measurement systems for industrial inspection; optical methods for arts and archaeology; and nano- and micro-metrology.

Held as part of the overall Laser 2005—World of Photonics congress from 13–17 June 2005 at the Fairgrounds in Munich, Germany, this year's metrology conference has attracted a record number of presentations.

There are a number of notable plenary papers, one of which is “Dedicated near-field microscopies for electronic materials and devices” by L. J. Balk of Wuppertal University (Wuppertal, Germany), et al. Additionally, a wide range of invited papers cover topics including modern approaches in phase measuring metrology, laser techniques in conservation

in Europe, and international standards for metrology of microlens arrays.

Other events held during the same week in Munich include the European Conference on Biomedical Optics, jointly organized by SPIE and the Optical Society of America; Lasers in Manufacturing, organized by WLT—The German Society for Laser Technologies; the EOS Conference on Industrial Imaging and Machine Vision, organized by the European Optical Society; the European Conference on Lasers and Electro-Optics (CLEO/Europe) in conjunction with the European Quantum Electronics Conference (EQEC); and the 15th Annual Meeting of the German Society for Laser Medicine.

The congress week accompanies the Laser 2005—World of Photonics Exhibition. SPIE and SPIE Europe will be represented in the exhibition to welcome new members in this 50th anniversary year.

@ For more event information, see spie.org/events/eom.

Human Wins Arm Wrestling 'Bot Battle' at Smart Structures Symposium

SPIE hosted a ground-breaking event in robotics history this March: the first-ever arm wrestling match between a futuristic robotic arm and a human opponent.

In three matches, 17-year-old Panna Felsen defeated each robotic opponent in times ranging from 24 seconds to three seconds. Felsen is a robotics hobbyist and straight-A student from La Costa Canyon High School in Carlsbad, north of San Diego.

The event was held 7 March during the Electroactive Polymer Actuators and Devices conference at SPIE's Smart Structures and Materials Symposium.

This event marked a milestone for the field of electroactive polymers (EAP). A robot win would have been a major milestone accomplishment for biomimetics, namely demonstrating the ability to emulate human physical capabilities—but robot fans will have to wait 'til next year.

Three organizations made EAP robot arms for the competition: Environmental Robots Inc. (Albuquerque, NM), Swiss Federal Laboratories for Materials Testing and Research (Dübendorf, Switzerland), and a group of students from Virginia Tech's Engineering and Mechanics Department (Blacksburg, VA).

The event's founder, Yoseph Bar-Cohen, a Senior Research Scientist at Jet Propulsion Laboratory (Pasadena, CA) and a SPIE member, aims to promote the vast scientific possibilities

Panna Felsen competes against her robotic arm wrestling opponent designed by a team of students from the Engineering Science and Mechanics Dept. at Virginia Tech.

surrounding artificial muscles. He proposed this challenge to develop a robotic arm actuated by artificial muscles to the research and engineering community in 1999. This recent match was the first time the challenge was answered.

Competition judges included: Bar-Cohen, chair; Dave Devoto, pioneer and leading representative, United States ArmSports (who provided a standard professional arm wrestling table for the competition); Richard Landon, contributor to the book *Biologically Inspired Intelligent Robots* (SPIE Press), Stan Winston Studio (designed and created the robots and makeup effects for Spielberg's movie *AI*); John D. W. Madden, Univ. of British Columbia; and Joanne Pransky, the world's first robotic psychiatrist.

This month at oemagazine.com you will find web-exclusive articles featuring:

- The latest news and announcements about SPIE members
- News from the Winter College on Optics and Photonics in Nanosciences and Nanotechnology

Singh Awarded USAC-ICO Traveling Lecturer Grant

SPIE member Jagdish P. Singh, Mississippi State University (Starkville, MS), traveled to India in December 2004 and January 2005 giving lectures at research institutes around the country, thanks to a traveling lecturer grant from the United States Advisory Committee to the International Commission for Optics (USAC-ICO).

Through this program the USAC-ICO aims to encourage research scientists to share their work on the latest advances in optical science and technology with fellow researchers in developing nations.

Singh visited several institutions throughout India, including the Indian Institute of Technology (IIT) Madras, IIT Kanpur, the Cochin University of Science and Technology, Allahabad University, and Banaras Hindu University. All of these institutions have active research groups in various areas of optics and laser technologies.

In addition to presenting lectures, Singh also explored the possibility of collaboration between these research centers and Mississippi State University.

@ Read more about Singh's travels in his report at oemagazine.com.

Jagdish P. Singh, of Mississippi State University, traveled to India on a USAC-ICO grant. He says, "I would like to encourage researchers active in optical science and technology to take advantage of this opportunity and help developing nations."

ICO NEWS

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- Topical meeting ICO '04 "Frontiers in Optics" Japan: The celebration of an international meeting place for optics and photonics technology and industrial applications.
- ICO Galileo Galilei Award 2004 shared by Milivoj Belic and Caesar Saloma: An insight on leadership on optics activities in a global community.
- International Workshop on Optoinformatics, Saint Petersburg, Russia, 18–21 October 2004: "Optics Meets ПТИК "
- In Memoriam: Aurelio Oliva Viera
- Forthcoming events with ICO participation

Please visit www.ico-optics.org for a full version of the newsletter.