Seidman honored for his contributions to understanding materials on the atomic scale

Northwestern Engineering’s David N. Seidman, whose work has led to an improved understanding of materials on the atomic scale, was one of 83 new members and 16 new foreign members elected to the National Academy of Engineering (NAE) in February.

Among the highest professional distinctions accorded to an engineer, Seidman was cited by NAE for “contributions to understanding of materials at the atomic scale, leading to advanced materials and processes.”

Seidman is a Walter P. Murphy Professor of Materials Science and Engineering and the founding director of the Northwestern University Center for Atom-Probe Tomography (NUCAPT), the largest atom-probe tomography group in the United States. NUCAPT’s equipment gives researchers the ability to see the internal structures of materials — on the subnano- to nanoscale — to help them better understand the materials’ properties and how those properties have temporally evolved. This information can be used to improve various materials’ properties, such as making them lighter and stronger.

“We are tremendously proud to see David recognized at the highest level in his field,” said Julio M. Ottino, dean of the McCormick School of Engineering. “Since joining Northwestern more than 30 years ago, he has been an example of an outstanding researcher, collaborator, and colleague.”

Seidman’s research aims to understand physical phenomena in a wide range of material systems on an atomic scale. His research group uses highly sophisticated microscopy and spectroscopy instrumentation to study interfaces on a subnanoscale level. He uses these tools to develop high-temperature cobalt-based alloys for use as turbine blades in aircrafts and for producing electricity.

Seidman has received several awards, including being selected twice as a John Simon Guggenheim Memorial Foundation Fellow and receiving an Alexander von Humboldt Stiftung Prize. He also has received an IBM Faculty Research Award, the Materials Research Society’s David Turnbull Lecture Award, ASM International’s Albert Sauveur Achievement Award and its Gold Medal, and the Max Planck Research Award from the Alexander von Humboldt Foundation and Max Planck Society.

He is a fellow of the American Academy of Arts and Sciences, American Association for the Advancement of Science, Materials Research Society, TMS, American Physical Society, International Field-Emission Society, Microscopy Society of America, and ASM International.
Dear Friends,

T
de the past year seems to have passed in a whirlwind of activities, and it is a pleasure to highlight some of them in this newsletter. Without a doubt, one of the highlights was the reunion and celebration of the Department of Materials Science and Engineering’s 60th anniversary in May. From the alumni panel discussion on Friday — which greatly inspired alumni, students, and faculty alike — to the lab tours, faculty presentations, and lively closing reception on Saturday, it was a wonderful celebration of the department and the people that have made it what it is.

Furthermore, on September 1, Jon Emery has been promoted to assistant professor of instruction. Jon plays an important role in modernizing our curriculum and I am happy that we can count on his insights and input.

On a more somber note, our university lost a beloved faculty member. Julia Weertman, one of our most influential and respected professors, passed away on July 31 at the blessed age of 92, along with many other faculty, had the opportunity to attend her memorial, and left with a deep admiration of how a person could simultaneously be so accomplished, have so many interests, and be such a beacon for the people around her. We will greatly miss her and wish Hans and her children strength. I would like to add that we will celebrate Julia’s impact on the department with a symposium on the Evanston campus on November 16, featuring friends, collaborators, and students.

As the upcoming academic year begins, we are preparing to welcome incoming class of 39 PhD students and 23 MS students. Graduate students and postdocs form the heart of our research activities, and every year it is exciting to welcome new members to our materials science and engineering “family.” I am also happy to note that we have received the green light to proceed planning a renovation of the undergraduate teaching lab, aided by a generous donation from one of our alumni. I will keep you informed of progress on this front.

In closing, allow me to thank all of you again for your interest in our department. I am always happy to hear your stories and will be glad to catch up in person if you happen to be in Evanston.

FOR THE CHAIR

From the Chair

JULIA WEERTMAN PASSES AWAY

Expert on nanocrystalline materials was the first woman to chair a materials science department in the United States

Julia R. Weertman, Walter P. Murphy Professor Emerita of Materials Science and Engineering at Northwestern University, passed away at age 92 on July 31. She will be remembered as a dedicated teacher, pioneering researcher, and valued colleague and friend.

Weertman made many noteworthy contributions to understanding the basic deformation processes and failure mechanisms in a wide class of materials, from nanocrystalline metals to high-temperature structural alloys. Her 1964 textbook, Elementary Dislocation Theory (Reprint, Oxford University Press, 1992), which she co-authored with her husband, Emeritus Professor Johannes Weertman, stands as the first book written specifically for undergraduate students on dislocation theory, an important factor in determining the behavior of crystalline materials.

She was the first woman admitted to the College of Science and Engineering at the Carnegie Institute of Technology, now Carnegie Mellon University, where she earned her bachelor’s, master’s, and PhD degrees in physics. She joined Northwestern’s Department of Materials Science and Engineering in 1972 as an assistant professor, teaching courses at both the undergraduate and graduate levels.

“Julia was an illustrious faculty member in our department and has always been deeply committed to it,” said Erik Luijten, professor and chair of the Department of Materials Science and Engineering at Northwestern’s McCormick School of Engineering. “She is remembered by many of her former colleagues for her warmth, inspiration, and seminal contributions to the field.”

In 1997, Weertman was appointed chair of Northwestern’s Department of Materials Science and Engineering, becoming the first woman in the country to hold the position within an engineering department. During her five-year tenure, the number of materials science undergraduate students more than doubled, and she recruited two new female faculty members to join the department.

Weertman’s career has been marked by many honors. In 2014, she received the prestigious John Fritz Medal from the American Association of Engineering Societies (AAES) in recognition of her role in the understanding of failure in materials and for inspiring generations of young women to pursue careers in the science and engineering fields.

That same year, the Department of Materials Science and Engineering established the Johannes and Julia Randall Weertman Graduates Fellowship in honor of the couple’s impactful contributions to materials science and to Northwestern.

In 2017, The Minerals, Metals & Materials Society (TMS) renamed its TMS Educator Award to the TMS Julia and Johannes Weertman Educator Award. This award celebrates an individual who has made outstanding contributions to education in metallurgical engineering and/or materials science and engineering.

Her other honors include membership in the American Academy of Arts and Sciences as well as the National Academy of Engineering (NAE). She was also a recipient of the ASM International Gold Medal in 2005, two Special Creativity Awards from Research for the National Science Foundation, a Guggenheim Fellowship, and a Distinguished Engineering Educator Award from the Society of Women Engineers.

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Mohan Liu (Wolferton) “High-throughput Hybrid-functional DFT Investigation of Materials Band Gaps and Formation Energies”

Fuyao Yan (Olson) “Materials for Additive Manufacturing — Design for Accelerated Qualification”

Che-Ning Yeh (Huang) “Stability of Graphene Oxide Membranes in Water: The Mystery, The Answer, and the Implications”

Jinghan Zhu (Mirkin) “Responsive Nanoparticle Superlatives”

Vuk Brajuskovic (Petford-Long) “Quasiquasitric Artificial Spin Ice — A Direct Observation of High Energy States”

Pangchen Chen (Mirkin) “Combinatorial Synthesis of Multicomponent Nanoparticles”

Seyoung Cook (Mark) “Revealing Defect-induced Behavior in Strontium Titanate Using In-situ Synchrotron X-ray Techniques”

Xuan Dua (Huang) “Self-dispersed Crumpled Graphene Balls for Lubrication Application”

Vinay Hedge (Wolferton) “Exploring the High-pressure Materials Landscape”

Matthew Jones (left) with Professor Chad Mirkin

ALUMNI HONORED

Charles Kuehmann and Nathan Guisinger received awards at the annual banquet

Two outstanding materials science alumni were honored at the 2018 Annual Alumni Celebration Banquet in May. Charles Kuehmann received the Distinguished Career Achievement Award, and Nathan Guisinger received the Early Career Achievement Award.

Charles Kuehmann

Kuehmann has been a leader in computational materials design since its inception. He currently leads the materials engineering organizations at both Tesla and SpaceX, driving material solutions to enable the world’s transition to a sustainable future, the commercialization of space, and a multi-planetary civilization.

Nathan Guisinger

Guisinger has developed a leading effort towards materials discovery, synthesis, characterization, and processing, including the discovery of new (low-dimensional) materials. He is a staff scientist at the Center for Nanoscale Materials at Argonne National Laboratory.

Top: Professor Greg Olson (left) presents the award to Charles Kuehmann; bottom: Nathan Guisinger (left) with Professor Mark Hersam

Upcoming Special Lectures

Dow Lecture: Lane Martin
University of California, Berkeley
November 30, 2018

Morris E. Fine Lecture: Gerbrand Ceder
University of California, Berkeley
February 6, 2019

Jerome E. Cohen Lectures: Frederico Capasso
Harvard University
May 6-7, 2019

John E. Dorn Lecture: Karin Rabe
Rutgers University
Spring 2019

CONTRIBUTIONS

MATERIALS SCIENCE AND ENGINEERING

Noel Mitrovic
The Dow Chemical Company
Evonik Corporation
MilliporeSigma
Questek Innovations LLC
United States - Israel Binational Science Foundation
Northwestern University • McCormick School of Engineering

Spencer Wells
2ND PLACE
Hierarchical Energy Storage Electrodes
Assembly of Hybrid Nanotubes for

Vinay Hedge (Wolferton) “Exploring the High-pressure Materials Landscape”

Northwestern University • McCormick School of Engineering

The 31st annual John F. Hilliard Symposium, organized by Professor Jianxing Huang, was held on May 17 in the Krebs Classroom at Northwestern’s North Campus Parking Garage/ Academic Building. Alumnus Matthew Jones (PhD ’14, Mirkin), delivered the keynote address, “Nanoparticles as Meta-Atoms: Thinking by Analyum in Chemistry and Materials Science.” Jones joined Rice University in 2017 as assistant professor of chemistry and the Norman and Gene Hackerman Junior Chair.

Speakers

1ST PLACE
Nicholas A. Sather (Shaps) “Directed Assembly of Hybrid Nanotubes for Hierarchical Energy Storage Electrodes”

2ND PLACE
Spencer Wells (Hersam) “Reactive 2D Materials: Challenges and Opportunities”

3RD PLACE
Ha-Kyung Kwon (Dvorkin) “Electrostatic Control of Ionomer Phase Behavior”

MORRIS E. FINE LECTURE
Rebecca Cunto, PhD
William G. Gentry, PE
Barbara M. Nicholas, PhD
Joseph S. Pucci, PhD
Mrs. Barbara K. Santner
Sayan Vayman, PhD and Ms.
Dora Vayman
Amir V. Vinkar, PhD

JOHANNES AND JULIA RANDALL WEERTMAN GRADUATE FELLOWSHIP FUND
Tao Wei Chen, PhD
Prof. David J. Durand
Stephen T. Ganzy, PhD
Jeffrey T. Galus, PhD
Mrs. Elaine M. Grossman Gnesi
Mrs. Joanne H. Gains and Mr.
Donald O. Gains, PhD
George William Harman, PhD and Ms.
Mrs. Yasuko Sakai
and Jennifer Saak, PhD

Donations made between July 21, 2017 and July 17, 2018. If you would like to contribute to MSE funds, please contact Patrick Hankey at p-hankey@northwestern.edu.

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Mrs. Susan Hersam
Hersam and
Robert Furlong

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Northwestern University • McCormick School of Engineering

Spencer Wells
2ND PLACE
Hierarchical Energy Storage Electrodes
Assembly of Hybrid Nanotubes for
The event was held May 18-19 on Northwestern’s Evanston campus.

Northwestern Engineering’s Department of Materials Science and Engineering celebrated its 60th anniversary with an alumni reunion on May 18-19, 2018. Guided by the theme, “Better Materials = Better Life,” the event brought together alumni from around the world for two days of networking, lab and facility tours, research presentations, and a reception with McCormick School of Engineering Dean Julio M. Ottino and Chair Erik Luijten.

The reunion was highlighted by an alumni-led panel discussion that tackled the unique career trajectories of MSE alumni, the impact of their Northwestern materials science education, and their vision of the field of materials science in the future. Moderated by Professor Mark Hersam, panelists included:

- Charlie Kuehmann (PhD ’94), vice president of materials engineering at SpaceX and Tesla Motors
- Cynthia Pierre (PhD ’09), inspection, materials, corrosion, and engineering superintendent at BP
- Boris Vuchic (PhD ’95), principal and owner at Pennant Capital
- Grace Wang (PhD ’01), vice chancellor for research and economic development at State University of New York
- Bryce Meredig (PhD ’12), founder at Citrine Informatics
- Michele St. Louis Weber (PhD ’96), senior director of the Internet of Things Group at Intel
- Brad Tinkham (PhD ’02), manufacturing engineering manager at II-VI EpiWorks
The Department of Materials Science and Engineering celebrates its PhD candidates who graduated between September 2017 and June 2018. They are listed below with their current job placements.

Tassie Anderson (Marks) Applied Materials
Itamar Balla (Horsam) Intel
Amit Kishan Behera (Olson) Questek Innovations
Sumit Bhattacharya (Saidman) Argonne National Laboratory
Zhenyu Bo (Noteostein) Micron Technology
Jeffrey David Cain (Draavid) Lawrence Berkeley National Laboratory
Gavin Paul Campbell (Bedzyk) Intel
Kavita Chandra (Saidman) Boston Consulting Group
Seyoung Cook (Marks) Intel
Lawrence Anthony Crosby (Marks) Intel
Antoine Alexandre Emery (Wolverton) Solvay Chemicals
Daniel Joseph Fairfield (Shupp) Aegis Sciences
Changrui Gao (Solvay) Solvay Chemicals
Lawrence celebrates its PhD candidates

- Divya Jain (Saidman) Intel
- Jooho Kang (Horsam) Lawrence Berkeley National Laboratory
- Kyoungdoc Kim (Wolverton) Northwestern University
- Sue Kim (Wolverton) MIT
- Michael Phan Knudson (Oddom) Intel
- Andrew Robert Koltonow (Huang) Cardinal Intellectual Property
- Ha-Kyung Kwon (Oliveira de la Cruz) Toyota Research Institute
- Won-Kyu Lee (Oddom) Harvard University
- Byungchon Lee (Chang) Hyundai Motor Group
- Qingyuan Lin (Mirkin) Boston Consulting Group
- Shuangping Liu (Oliveira de la Cruz) Lawrence Berkeley National Laboratory
- Zhi Lu (Wolverton)
- Andrew Jacob Mannix (Seidman) Northwestern University
- Tassie Anderson (Marks) Applied Materials
- Itamar Balla (Horsam) Intel
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- Lawrence Anthony Crosby (Marks) Intel
- Antoine Alexandre Emery (Wolverton) Solvay Chemicals
- Daniel Joseph Fairfield (Shupp) Aegis Sciences
- Changrui Gao (Solvay) Solvay Chemicals
- Lawrence University
- Eve Dorthea Townsend Hanson (Draavid) Citrine Informatics

Department Celebrates ITS RECENT PHD GRADUATES

Northwestern Receives Mellon Foundation Grant for Scientific Studies in the Arts

The grant includes a permanent endowment to support the position of a co-director for the Center for the Scientific Studies in the Arts.

Northwestern University has received a $3.5 million grant from The Andrew W. Mellon Foundation to support the Center for the Scientific Studies in the Arts, a collaborative partnership with the Art Institute of Chicago to investigate and conserve art. The grant includes two components: $2.5 million in spending funds to support the center over five years, and $1 million as a permanent endowment to support the position of a center co-director at Northwestern. In order to receive the permanent endowment, the University must raise $2 million in matching funds over the next four years. All funds count toward We Will. The Campaign for Northwestern.

“The fundraising effort is an exciting part of the grant,” said Marc Walton, the center’s co-director and research professor of materials science and engineering in Northwestern’s McCormick School of Engineering. “The University is putting support and infrastructure into this goal because it sees value in work taking place at the intersection of art and science.”

With the Mellon Foundation’s continued support, the center will expand its core program to offer scientific tools and expertise to institutions across the country as well as bolster its educational efforts with additional classes, workshops, and conferences. The grant will fund a new program called Idea Labs, which will support new collaborations among scientists and art conservators, historians, curators, and others who could benefit from exploring artistic objects through scientific analysis.

Researchers Predict Materials to Stabilize Record-High Capacity Lithium-ion Battery

Advancement could pave the way for less expensive, longer-lasting batteries for electric vehicles

Professor Christopher Wolverton

Northwestern University

The computations pinpointed two elements: chromium and vanadium. The team predicts that mixing either element with lithium-manganese-oxide will produce stable compounds that maintain the cathode’s high capacity.

After compressing a detailed, atom-by-atom picture of the cathode, Wolverton’s team discovered the reason behind the material’s high capacity: It forces oxygen to participate in the reaction process. By using oxygen — in addition to the transition metal — to store and release electrical energy, the battery has a higher capacity to store and use more lithium. Next, the Northwestern team used high-throughput computations to scan through the periodic table to find new ways to alloy the compound with other elements that could enhance the battery’s performance and prevent swift degradation.

Professor Christopher Wolverton

One of the Center’s projects discovered that ancient artists used the pigment Egyptian blue for underdrawings.
**Professor Sossina Haile**

**Sosanna Haile** was elected fellow of the Materials Research Society for her leadership in engaging the international community of materials researchers.

**FACULTY NEWS**

**Professor Monica Silveira da Cruz**

Monica Oliveira de la Cruz received $4.5 million from the Sherman Fairchild Foundation to accelerate the discovery of new functions and application of synthetic structures.

**John Rogers**’ innovative “Lab on the Skin” invention was featured as part of an art exhibit at the Museum of Modern Art (MoMA).

**Discovery presents a significant step toward lower fuel cell costs and more sustainable energy**

A team of researchers led by Professor Sossina Haile has created a new fuel cell that offers both exceptional power densities and long-term stability at optimal temperatures, a discovery that heightens the viability of incorporating fuel cells into a sustainable energy future.

For years, industry has told us that the holy grail is getting fuel cells to work at 500 degrees Celsius and with high power density, which means a longer life and less expensive components,” Haile said.

**New fuel cell has exceptional power density and stability**

**SOSNNA HALE**

“With this research, we can now envision a path to making cost-effective fuel cells and transforming the energy landscape.”

**SOSSINA HALE**

**Stretchable Electronics a ‘Game Changer’ for Stroke Recovery Treatment**

New wearable device developed in partnership with Shirley Ryan AbilityLab

**The new sensor measures stroke patient’s patterns of speech.**

**New wearable device developed in partnership with Shirley Ryan AbilityLab**

A groundbreaking new sensor designed to be worn on the throat could be a game changer in the field of stroke rehabilitation. Developed in the lab of Professor John A. Rogers, in partnership with Shirley Ryan AbilityLab, the sensor is the latest in Rogers’s growing portfolio of stretchable electronics.

“Stretchable electronics allow us to see what is going on inside patients’ bodies at a level traditional wearables simply cannot achieve,” Rogers said. “The key is to make them as integrated as possible with the human body.”

The new bandage-like throat sensor measures patients’ swallowing ability and patterns of speech. The sensors aid in the diagnosis and treatment of aphasia, a communication disorder associated with stroke. Shirley Ryan AbilityLab, a research hospital in Chicago, uses the throat sensor in conjunction with electroencephalography — also developed in Rogers’s lab — on the legs, arms, and chest to monitor stroke patients’ recovery progress. The intermodal system of sensors streams data wirelessly to clinicians’ phones and computers, providing a quantitative, full-body picture of patients’ advanced physical and physiological responses in real time.

**Strechable Electronics a ‘Game Changer’ for Stroke Recovery Treatment**

**FACULTY NEWS**

**Professor Mark Her zam**

Mark Hersam was elected to the National Academy of Inventors. He also received the 2017 Nanotechnology Recognition Award from the American Vacuum Society (AVS).

**STUDENT NEWS**

**Eric Anderson**, Kyle Bushick, Jose Martinez, and Yakira Mirabito received second place in the 2017 ASM Undergraduate Design Competition for their project, “TRIP: Tailors for Additive Manufacturing,” supervised by graduate student Fan Meng and Professor Greg Olson.

**Emily Hoffman**

Emily Hoffman (PhD ’16, Marks) received the Outstanding Collegiate Member Award from the Society of Women Engineers.

**Brian Ingram** (PhD ’04, Mason) and George Crabtree (advisory board) represented the Joint Center for Energy Storage Research (JCESR) team led by Angone in receiving the Secretary of Energy’s Achievement Award.

**Todd Steyer** (PhD ’93, Faber) was named to Forbes’ “30 Under 30: Science” for 2018.

**New Faculty Cell has Exceptional Power Density and Stability**

**Discovery presents a significant step toward lower fuel cell costs and more sustainable energy**

**FACULTY NEWS**

**Professor Yizong Huang**

Yonggang Huang was selected as a foreign member of the Chinese Academy of Sciences.

**New wearable device developed in partnership with Shirley Ryan AbilityLab**

**Matthew Cheng**

NSF Graduate Fellowships were awarded to Matthew Cheng (Shavl), Thomas Cetey (Shavl), Liban Jibril (Mirkin), Jacob Kupperberg (Shavl), Kelly Parker (Dravid), Melissa Puga (Mirkin), and Kristen Wek (Shavl).

**Jacob Song** (BS ’17) was recognized as the 2017 USA and Canada Regional Winner in Engineering from The Undergraduate Awards.

**Kelsey Stoerzinger** (BS ’10) was named assistant professor of chemical engineering at Oregon State University.

**2018 Engineering Materials Achievement Award**

**ANNE CRABTREE**

Professor Anne Crabtree was elected to the National Academy of Engineering.

**2018 MML Early Career Faculty Fellow Award**

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**2018 ACerS Outstanding Educator Award**

**Emily Hoffman**

Emily Hoffman (PhD ’16, Marks) received the 2018 ACerS Outstanding Educator Award.
Graphene Finds New Application: Hair Dye

Dyeing your hair too often can damage those silky strands irreparably. Professor Jiaxing Huang and his team have leveraged the super material graphene to develop a new non-damaging hair dye that lasts through many washes without fading. Huang and his team bypassed harmful chemicals altogether by leveraging the natural geometry of graphene sheets.

While currently available hair dyes use a cocktail of small molecules that work by chemically altering the hair, graphene sheets are soft and flexible, so they wrap around each strand of hair for an even coat. Huang’s ink formula also incorporates edible, non-toxic polymer binders to ensure that the graphene sticks — and lasts through at least 30 washes. Graphene is anti-static, so it keeps winter-weather flyaways to a minimum, and its conductive nature opens up new opportunities for hair, such as turning it into in situ electrodes or integrating it with wearable electronic devices.