

MATERIALS NEWS UPDATE

UC SANTA BARBARA
Materials

2024-2025

Dear Friends,

We hope this message finds you well, and that you are thriving in your respective endeavors!

For the Materials Department, it has been a year of change. Prof. Michael Chabynec stepped down as Chair last summer after a herculean 6 years of leading the Department, including through the pandemic. Also, Prof. Tresa Pollock, who was serving as interim Dean of the College of Engineering, relinquished that role. Let me express my profound gratitude to both of them for their extraordinary service to the Department, College, and Campus.

I am pleased to announce the appointment of Prof. Umesh Mishra as the new Dean of the College of Engineering. Prof. Mishra is of course well-known to the Materials Department through his long-standing interactions with our Electronic & Photonics section, and we look forward to working with him in his new role. And, of course, I personally have the tall task of trying to fill Michael's shoes, having been appointed as Chair of Materials last July.

While the leadership has changed, the extraordinary strength of our Department continues, as is particularly visible through our continued record of garnering faculty awards. Among a long list of laurels, let me highlight the election of Prof. Irene Beyerlein to the National Academy of Engineering. Her election means that a full 13 of our current faculty are members of one of the National Academies—this is more than a third of the Department! Our graduate students also continue to achieve at a high level—and let me take this opportunity to thank alumni Dr. Mason Hu ('89) and Dr. Sheila Hurr ('00) for their generous recent donations, which have significantly helped us in recruiting top students, and supporting their activities.

We have added a new faculty member, Prof. Jeff Sakamoto, who joins us as the Mehrabian Endowed Chancellor's Chair. Prof. Sakamoto has made a range of advances in the study of solid-state battery materials, and strengthens our growing Functional & Quantum materials sub-section. Sadly, I must also note the passing of Prof. Herb Kroemer, 2000 Nobel Laureate in Physics, who was instrumental in pushing our program to its current prominence. On a personal level, I recall the support Herb always gave to me when I was a young professor, and I appreciate his amazing textbook that I used for years in teaching graduate thermodynamics.

I hope you enjoy hearing about our Department's activities, and I look forward to seeing each of you soon.



Yours,



Omar Saleh, Chair
Department of Materials

Materials, By the Numbers

- | | |
|--|---|
| #1 Materials Department, National Research Council | 10 National Academy of Engineering (NAE) members |
| #2 Public Materials Graduate Program, U.S. News & World Report (2024) | 7 National Academy of Inventors (NAI) members |
| 132 Graduate Students (Fall 2023) | 2 National Academy of Sciences (NAS) members |
| 32 MS and PhD Degrees Awarded (2022-'23) | 4 Highly Cited Researchers, Clarivate Analytics |
| 33 Faculty, including: | 8 American Physical Society (APS) Fellows |
| 3 Nobel Laureates (historically) | |

Student Awards & Recognition



Left to right: Kyra Wyckoff, Ram Seshadri, and Linus Kautzsch receive their awards for winning the New Venture Competition.

Kyra Wyckoff and **Linus Kautzsch** won the grand prize at UC Santa Barbara's 24th Annual New Venture Competition (NVC) Finals. The final marked the culmination of the Technology Management (TM) Department's rigorous eight-month technology business plan competition that was open to students from all disciplines at UCSB. Wyckoff and Kautzsch's team, Leeta, pitched a faster and more sustainable manufacturing process to close the supply-and-demand gap for lithium-ion battery materials.

Student Fellowships

National Science Foundation Graduate Research Fellowship

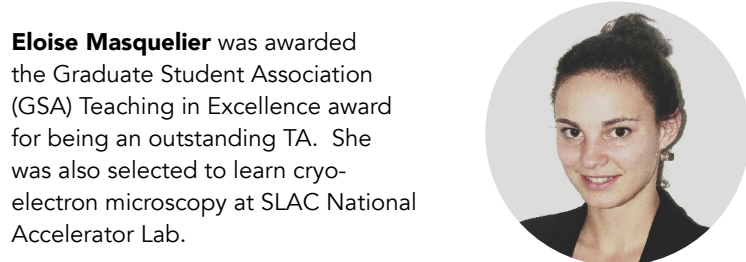
Arsineh Apelian
 Jake Ewing
 Pat Getty
 Evan Guo
 Hannah Howard
 Lillian Hughes
 Art Kongruengkit
 Simon Munyan
 Akash Ram
 Andrew Rhode
 Emily Trageser

National Defense Science and Engineering Graduate Fellowship

Morgan Jones
 Bailey Rhodes
 Tanay Tak

AirForce Research Laboratory Fellowship

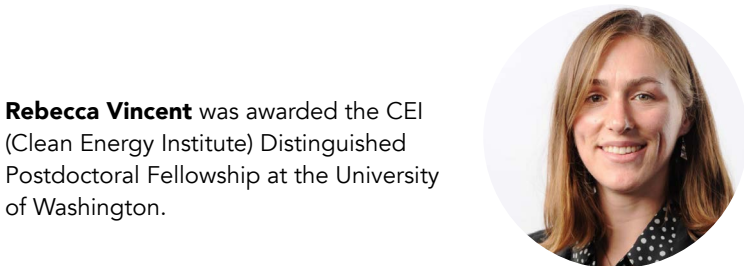
Nolan Hendricks



Eloise Masquelier was awarded the Graduate Student Association (GSA) Teaching in Excellence award for being an outstanding TA. She was also selected to learn cryo-electron microscopy at SLAC National Accelerator Lab.



Allison Chau was selected to join an exclusive group of around 600 graduate students from all around the world to attend the 72nd Lindau Nobel Laureate Meeting.



Rebecca Vincent was awarded the CEI (Clean Energy Institute) Distinguished Postdoctoral Fellowship at the University of Washington.



Ian Wise was recently accepted into the UC National Laboratory Fees Research Program.

New Faculty Profile:

Jeff Sakamoto



Jeff Sakamoto joined the Materials Department as a professor and the Mehrabian Endowed Chancellor's Chair in November 2023. His research focuses on the area of functional ceramics. Ceramics are an important materials class ubiquitously found in a variety of applications, from high thermal barrier coatings, to thermoelectrics, semiconductors, and electrode and solid electrolyte materials. He has made significant advances in the area of ionically-conducting ceramics, or ceramic ion conductors (CICs), that are critical materials for high-energy density, safe solid-state batteries.

Currently, his group is investigating how to design, develop, and manufacture new materials to enable the next generation of battery technologies. It is widely accepted that electrochemical energy storage will play a major role in creating a more sustainable future that relies on electrical rather than fossil fuel energy. His research is focused on solid-state ionic conductors

“...these [solid state ionic conductors] exhibit unprecedented stability, allowing the use of Li metal electrodes that have ten times the capacity compared to state-of-the-art Li ion electrodes.”

that can transport Li and Na ions as fast as liquid electrolytes. Moreover, many of these materials exhibit unprecedented stability, allowing the use of Li metal electrodes that have ten times the capacity compared to state-of-the-art Li ion electrodes. However, there remain fundamental knowledge gaps in understanding how these solid electrolytes can replace liquid electrolytes that are currently used in conventional batteries. Examples of some of the scientific questions he is trying to answer are: What controls the stability and kinetics of solid electrolyte-solid electrode interfaces? How does the coupling of mechanical and electrochemical forces affect the operation of interfaces? How to manufacture solid electrolyte and solid-state batteries

at scale and at low cost? Through broad collaboration and multidisciplinary research, he hopes to bridge these knowledge gaps to accelerate the adoption of higher performance and safe electric vehicle (EV) batteries and low-cost electrical grid batteries.

Prof. Sakamoto received his Ph.D. in Materials Science and Engineering from the University of California, Los Angeles. He subsequently rose to Senior Staff Scientist at the NASA/Caltech/Jet Propulsion Laboratory. He is a former faculty member of Michigan State University and the University of Michigan, Ann Arbor.

FACULTY AWARDS AND RECOGNITION



Irene Beyerlein

Mehrabian Interdisciplinary Professor, College of Engineering & Professor, Mechanical Engineering and Materials

Irene Beyerlein was elected to the National Academy of Engineering (NAE) in March 2024. She was cited by the NAE "For methodologies predicting the mechanics of complex engineering materials to improve their stability and strength." Prof. Beyerlein became the eleventh NAE member among the active faculty in UCSB's Materials Department.



John Bowers

Fred Kavli Distinguished Professor, Electrical & Computer Engineering & Distinguished Professor, Materials

John Bowers has been selected to receive the 2024 Jun-ichi Nishizawa Prize from the Institute of Electrical and Electronics Engineers (IEEE) for his "contributions to photonic

integrated circuit technologies." The Nishizawa Prize is among the most prestigious given by the IEEE. Nominees are evaluated based on criteria that include the quality of one's technical achievement, the extent to which their innovations have enhanced technology, the impact of their innovations on the relevant technical community and the profession, and their benefit to society through publications and patents. Bowers gives abundant credit to the graduate students and postdoctoral researchers in his group for their work in advancing photonic research over the years.



Raphaële Clément

Assistant Professor, Materials

Raphaële Clément was awarded two highly regarded honors for junior faculty: the 2023 Rising Star Award from Materials Today and the 2023 International Society of Electrochemistry (ISE) Prize for Electrochemical Materials Science. Materials Today, the world's largest publisher of peer-reviewed materials science and technology content, annually recognizes exceptionally capable researchers who possess the potential to become future leaders in the field. A panel of judges selected Clément in the field of energy conversion and storage. ISE honored Clément for her innovative work in the field of electrochemical

materials science, including corrosion, electrodeposition, and surface treatment.



Craig Hawker

Alan & Ruth Heeger Chair in Interdisciplinary Science, Chemistry & Distinguished Professor, Materials

Craig Hawker was awarded an honoris causa, Honorary Doctorate, from the Eindhoven University of Technology, Netherlands (TU/e) during the TU/e Research Day in June 2023. His nominators note, "With his innovative ideas he has changed the polymer world," adding "In one way or another, he has contributed to every major development in polymer research over the past decades."



Robert McMeeking

Tony Evans Distinguished Professor, Materials & Distinguished Professor, Mechanical Engineering

Robert McMeeking received the 2023 Platinum Medal of the United

A snapshot of major awards and recognitions received by faculty from UC Santa Barbara's Materials Department within the past year.

Kingdom's Institute for Materials, Minerals & Mining (IOM3). The medal, which was first awarded in 1938, is given to recognize outstanding contributions to a field of interest within the materials, minerals, or mining sector. According to IOM3's announcement, McMeeking "has made highly original and influential contributions on a wide range of topics within the overall field of micromechanics: the relationship between microstructure, performance and failure of engineering materials across length scales and time scales. He has inspired a whole new generation of mechanics researchers in Engineering and Materials Science both in the US and in the UK."



Shuji Nakamura
CREE Distinguished Professor, Materials

Shuji Nakamura has received the 2023 LpS Digital Achievement Award from the LED professional Symposium, a large industrial consortium that supports LED research and applications. Prof. Nakamura was specifically recognized for "His impactful contributions to the energy and lighting sectors, his dedication to global sustainability, and his support for ongoing research in laser/LED technology, along with his efforts towards fostering a cohesive global society."



Tresa Pollock
ALCOA Distinguished Professor, Materials

Tresa Pollock has been honored by her peers with the 2024 William D. Nix Award from The Minerals, Metals & Materials Society (TMS), a testament to her impact on materials, on graduate students as an advisor, and on junior professionals in the field as a mentor. The prestigious annual award recognizes an individual whose work has had a significant and lasting impact on the underlying mechanisms and/or mechanical behavior of materials. Pollock was cited for her "seminal contributions to the creep and fatigue behavior of structural alloys and underlying deformation mechanisms, and for inexhaustible devotion to the mentoring of early career scientists."



Chris Van de Walle
Herbert Kroemer Distinguished Professor, Materials

Chris Van de Walle was awarded the 2023 Materials Theory Award from the Materials Research Society (MRS).

The MRS is the leading professional society dedicated to advancing materials science. The society gives a single Theory Award each year, in recognition of "exceptional advances made by materials theory to the fundamental understanding of the structure and behavior of materials." He was specifically recognized for his contributions in developing ab initio methodologies for understanding the effect of point defects on light emission in wide bandgap semiconductors. This award is a significant milestone in Van de Walle's remarkable research career, during which he has coupled mastery of computational and condensed matter physics with an ability to identify critical challenges for technological applications.



Vojtech Vleck
Assistant Professor, Chemistry and (by courtesy) Materials

Vojtech Vleck was one of 126 early-career researchers who was selected to receive a Sloan Research Fellowship in 2024. Awarded annually since 1955, the fellowships honor exceptional U.S. and Canadian researchers whose creativity, innovation, and research accomplishments make them stand out as the next generation of leaders. They are also often seen as a marker of the quality of an institution's science faculty and proof of an institution's success in attracting the most promising junior researchers to its ranks.

Mason Hu

Materials Alumni Profile

Mason Hu completed his PhD at UC Santa Barbara in 1989 and became one of the first graduates of the newly formed Materials Department. More than thirty years later, Hu, who recently retired from the Fortune 500 digital-communications company Cisco Systems, Inc., feels tremendous pride in being an alumnus of the highly regarded department.

"It's really exciting to see the College of Engineering and the Materials Department be considered among the best in the nation and in the world," said Hu. "I'm extremely proud to be a member of the community."

Hu has worked in various engineering capacities since earning his PhD from UCSB. His experience covers the manufacturing and assembly of printed circuit boards (PCBs), semiconductor packaging, and supplier management. His responsibilities at Cisco Systems, Inc., which he joined in 2000, included working with component suppliers, ensuring the quality of components and products, and technology development.

Hu entered the materials PhD Program at UC Santa Barbara in 1985 for one reason, to learn from and work alongside the department's founding chair, Anthony (Tony) Evans. An expert on the properties and behavior of advanced structural materials, Evans pioneered a new understanding of the structure of ceramic-matrix composites and the mechanics of toughening brittle materials.

"I read a lot of his work and reached out to him directly," said Hu, who received a bachelor's degree in chemical engineering from National Taiwan University and a master's degree in chemical engineering from Cornell University. "I told him about my background in chemical engineering, but that I really wanted to get into the semiconductor field, which was booming at the time."

Rather than advising him to look elsewhere, Evans, who died in 2009, introduced Hu to the "research without walls" mentality that has since become the very foundation of the Materials Department and College of Engineering.

"He told me that the true spirit of the program and

the college was embracing interdisciplinary research and collaboration," recalled Hu. "We created an academic plan with that in mind."

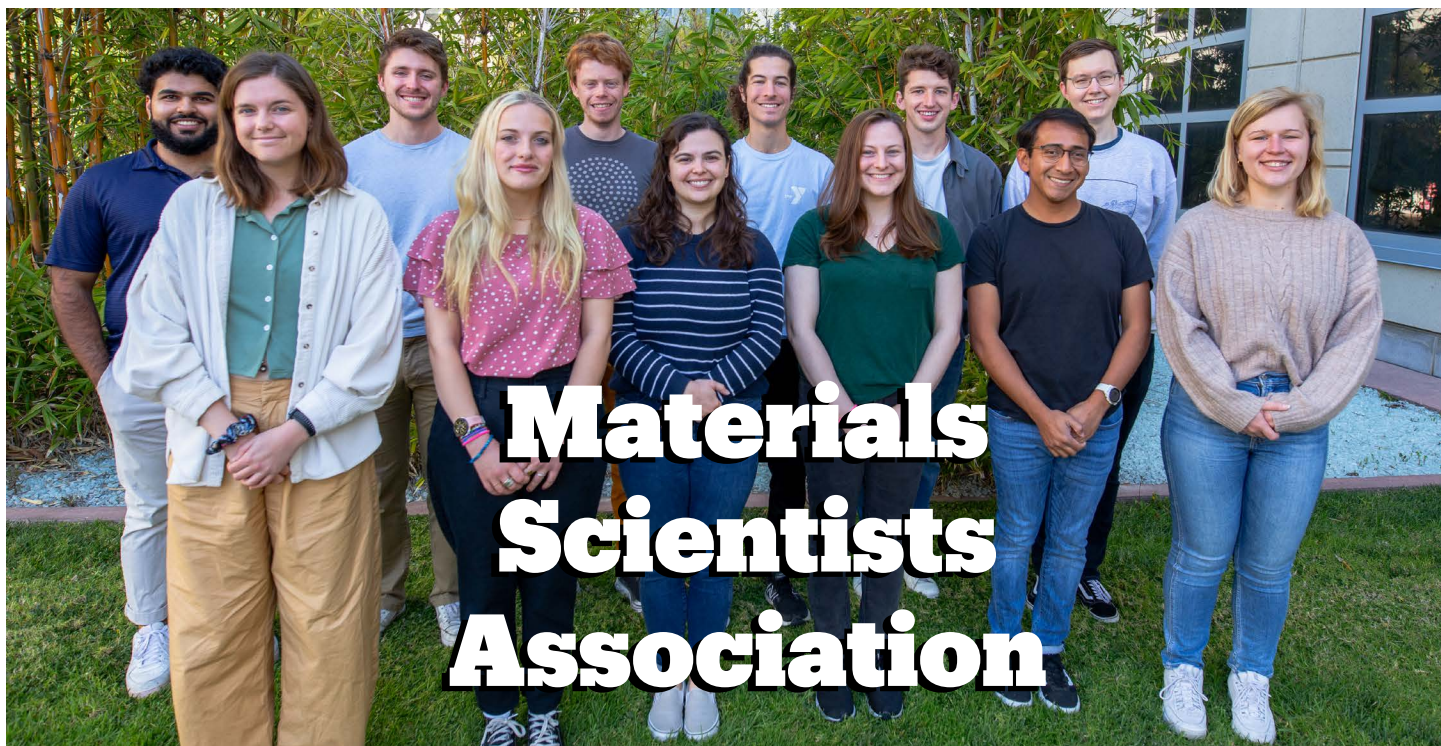
With Evans serving as his advisor, Hu studied the mechanical properties of thin-film material on substrates. He also worked alongside electrical engineering students in a lab preparing his samples and satisfying his passion for understanding and making semiconductors. Years after first experiencing and benefitting from interdisciplinary research, Hu says that the approach remains just as effective at Cisco, where he served as the company's director of supply chain operations until his retirement.

"With any new technology that we are developing, such as chips, you need interdisciplinary collaborations to succeed. You need to attack a problem from so many different angles in order to find the best solution," said Hu. "Thankfully, that mentality was instilled in me early in my career at UCSB."

To help support other engineers and scientists launch successful careers, Hu and his wife, Dorice, founded the Bright Horizon Global Foundation a few years ago, proclaiming a mission to positively impact society by investing in education. They donated to UCSB's Materials Department to establish community-service awards, graduate-student fellowships, and graduate student travel support for professional development. The Bright Horizon Global Foundation Materials Department Service Awards are given annually to recognize emerging leaders in materials science for their contributions beyond the laboratory and classroom.

"I believe that education is extremely important and key to changing someone's odds of success," said Hu. "I'm grateful that my wife and I are in a position to influence the trajectory of students and do what we can to make the world a better place."





Top row, left to right: Tanay Tak, Owen Kuklinski, Nico Fuchs-Lynch, Andrew Rhode, Patrick McNutt, Steve Skala
Bottom row, left to right: Melina Endsley, Rachel Kahler, Ashley Wissel-Garcia, Alex Zele, Arturo Juan, Kaitlyn Mullin

Greetings from the Materials Scientists Association (MSA; formerly known as the Materials Students Association)! The MSA is an organization for UCSB Materials students, postdocs, and staff, focused on promoting social cohesion within the department, providing professional development opportunities for students and postdocs, and working to advocate on behalf of all members within the Materials department at UCSB.

We have had a very productive and active year: The social committee helped welcome new students and faculty with a department-wide BBQ at the beginning of the fall quarter, and since then has helped grow connections with other graduate students in 5 different departments on campus through various events. They also hosted numerous faculty-student lunches throughout the year to foster stronger relationships between the two groups; in the upcoming year, these lunches will be expanded to also host the administrative staff and staff scientists to strengthen these relationships too. A joint effort between the social and professional development committees introduced a new event, a "Women in Materials" trivia night at a local brewery, that allowed for networking and built new relationships between the women faculty, staff scientists, post-docs, and students across the Materials department; similar events are in the plans for the future.

The professional development committee helped graduate students and postdocs consider next career steps through various industry speaker seminars and a career panel, and they also assisted members with their LinkedIn profiles and resumes through various workshops. They interfaced with 12 different companies over the past year, which spanned all major materials sub-disciplines; future plans from the PD committee involve a staff scientist career panel and continuing the industry speaker seminars.

The outreach committee made an impact both internally and externally; for the former, they took on the first year mentorship program and worked to plan events to help first year students integrate into the department and graduate school as a whole; recent efforts for this have included a "First Year Advice" series that covers various topics from older students on how they have navigated graduate school thus far. Externally, the outreach committee has coordinated volunteers with the MRL to bring materials students into the larger Santa Barbara community for various events; additionally, they have orchestrated beach clean-ups locally, which continue to be planned in the year to come. This year, relating to its recent name change, the MSA is also forming a postdoc committee, to enable better advocacy and plan more relevant events for them within the department.

The MSA is excited to continue growing and serving the UCSB Materials department, and is very grateful for the support of all current members and alumni!

Sincerely,

Melina Endsley



Melina Endsley
MSA President 2024
PhD Candidate, Pollock & Levi Groups

In Memoriam **Herb Kroemer**

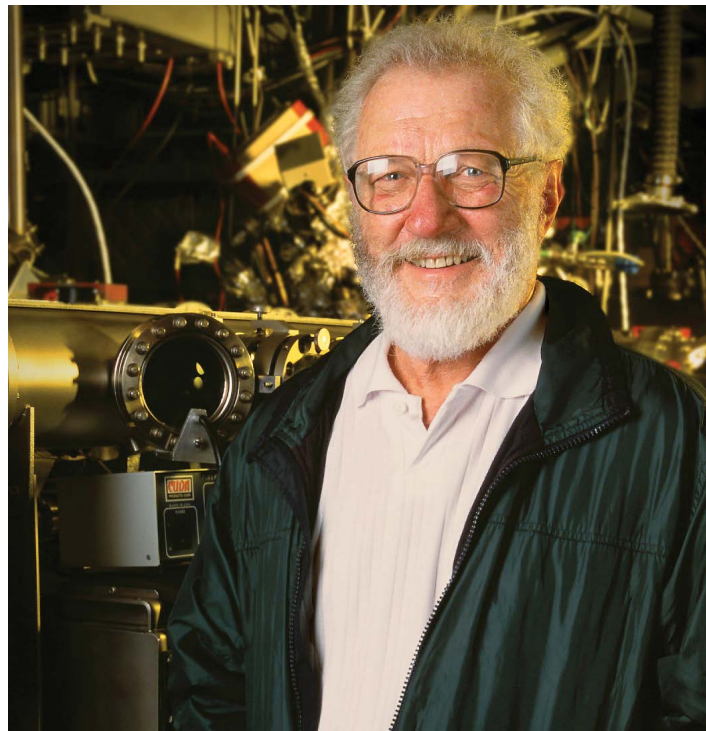
A beloved campus colleague and one of the greatest technological visionaries of our time is gone. UC Santa Barbara emeritus professor Herb Kroemer, who earned a Nobel Prize for his seminal work on compound semiconductors, died March 8, at the age of 95.

Born August 25, 1928, in Weimar, Germany, Professor Kroemer received a PhD in theoretical physics from Georg August University in Göttingen, Germany, in 1952, writing his dissertation on so-called hot-electron effects in the then-new transistor. That research set the stage for a career in research focused on the physics and technology of semiconductors and semiconductor devices.

Following work in several research laboratories in Germany and the United States, Kroemer came to UCSB in 1976, where he held the Donald W. Whittier Chair in Electrical Engineering, and was jointly appointed in the Materials Department and the Electrical and Computer Engineering Department.

Upon his arrival at UCSB, Kroemer persuaded the Electrical & Computer Engineering Department to direct a substantial portion of its limited resources to expanding the department's small semiconductor research program, with a particular focus on the emerging field of compound semiconductor technology. Seeing an opportunity for UCSB to become a leading institution in that area, Kroemer himself became the first member of what would become one of the world's preeminent groups dedicated to the physics and technology of compound semiconductors and the many devices they enable. This group would later include a range of preeminent Materials faculty, such as Professor Art Gossard and Professor Shuji Nakamura. Indeed, Nakamura, also a Nobel Laureate, notes "Herb made numerous fundamental, long-lasting contributions. His concept of the heterostructure for optical devices helped me to invent the blue LED and solid-state lighting."

Kroemer became one of the early pioneers in molecular beam epitaxy (MBE), concentrating from the outset on applying the technology to new materials systems. His work provided a great stimulus toward technological development. His discoveries provided the basis for numerous technological innovations we now use on a daily basis – from cell phone



and satellite communications, to high-speed transistors and solid-state lighting. Since the late 1990s, Kroemer reverted to purely theoretical work, some of which continued earlier work and some in newer research areas, such as electromagnetic wave propagation in photonic crystals and the physics of nanostructures.

In addition to his research accomplishments, Kroemer was an extraordinary educator. Professor Chris van de Walle, who is the Herbert Kroemer Endowed Chair in Materials Science, notes "Herb excelled as a teacher, as exemplified by his textbooks on Thermal Physics and Quantum Mechanics for Engineering. Countless students benefited from his mentorship; many credit their success in science to the passion that Herb instilled in them."

Kroemer received the Nobel Prize in Physics in 2000, with the citation reading "for developing semiconductor heterostructures used in high-speed- and opto-electronics." This award can ultimately be traced to his early papers at UCSB. In addition to the Nobel Prize, Kroemer received numerous national and international honors and awards, including the 2002 IEEE Medal of Honor "for contributions to high-frequency transistors and hot-electron devices, especially heterostructure devices from heterostructure bipolar transistors to lasers, and their molecular beam epitaxy technology." In 2001, he received the Grand Cross of the Order of Merit of the Federal Republic of Germany, the highest award given by the German government. He was a member of both the National Academy of Engineering and the National Academy of Sciences, and a fellow of the American Physical Society and the Institute of Electrical and Electronics Engineers.