On the Cover: Jason Bolsing, Optical light micrograph of base metal, heat-affected zone (HAZ), and fusion zone (FZ) of a resistance spot weld in 5754 aluminum alloy, as part of a dissimilar spot weld between aluminum and steel. The base metal and HAZ are visible in the lower left portion of the micrograph, and the FZ is located in the upper right portion of the micrograph. The fusion line, separating the HAZ and FZ, inserting the image from top-left to lower-right. In the HAZ, partial dissolution of the base metal precipitates, due to the resistances welding thermal cycle, is observable as white precipitate-free regions. The color variations in the micrograph are indicative of differences in chemical composition. Color etch with Weck’s reagent. Original magnification 500X.

Annual Report 1

Table of Contents
- Advisory Committee ...................................................... 1
- Mission Statement .......................................................... 1
- Executive Summary ......................................................... 1
- CMP Staff ................................................................. 2
- Forging Ahead .............................................................. 4
- Problem Solving Power ................................................... 5
- CMP Supported and Associated Graduate Students ............. 6
- Thesis/Dissertation Titles ................................................ 11
- Undergraduate Research Spotlight ..................................... 12
- Three Goldwater Scholars Awarded to Engineering Vols ............. 13
- Ready for What’s New .................................................... 14
- Unlocking Potential ....................................................... 15
- Program Overview and Accomplishments ...................... 17
- Unlocking Potential ....................................................... 15
- Executive Summary ......................................................... 1
- CMP Staff ................................................................. 2
- Future Goals and Plans .................................................. 19
- CMP 2019-20 Publications ................................................ 20

Advisory Committee
Established in early 2014, the CMP Advisory Committee works with the CMP Director Claudia Rawn and Associate Director for Industrial Partnerships and Undergraduate Research Michael Hammond regarding various areas of research. CMP can advocate for and invest in for the future. The CMP leadership and the Advisory Committee are working together to achieve the goal of bringing positive recognition to CMP, the Tickle College of Engineering, and the University of Tennessee in areas related to materials processing. In early August 2019, the CMP Advisory Committee met to begin discussing how CMP can help provide a link between local industry and the University of Tennessee.

Sudarsanan Suresh Babu, PhD
enameed as an advocate in the field of materials processing at many levels, including recruiting outstanding undergraduate and graduate students, advancing research, and engagement in materials processing-related fields. Current areas of specific interest include advanced manufacturing, materials characterization, crystal growth, scintillation detectors, nuclear materials, and energy-related materials. An important component of CMP’s mission is transferring research outcomes to industry and supporting industry partners and collaborators. To address technology transfer, CMP offers industrial memberships, where membership funds can be used to support students and/or access to facilities. Through these memberships, students gain valuable academic and industry experience while companies improve their competitive advantages by gaining access to a variety of research equipment. Serving the Tennessee community through industrial relationships has been a top priority for CMP in 2019-2020 and will continue to be in the coming years. CMP offers partially or fully supports both graduate and undergraduate student assistantships through stipends. To help students advance their processing research projects, CMP also provides support for trips on state-of-the-art instruments including electron microscopes and laboratory X-ray diffractometers. CMP also maintains key pieces of processing equipment for CMP-supported students and industrial members to use. Lastly, CMP annually sponsors several competitive poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges. The student winners are provided travel support to present their research externally and attend poster sessions with both faculty and outside representatives serving as judges.
Claudia Rawn  
Director

Claudia Rawn has been director of CMP since 2012. She is an associate professor in the Department of Materials Science and Engineering (MSE) at the University of Tennessee (UT) and has taught Introduction to Materials Science and Engineering, X-ray Diffraction and Structural Characterization of Materials, and Principles of Ceramics, and is one of the original faculty associated with the Materials Processing course that was first introduced to MSE in 2005. Rawn has served as chair of the MSE Undergraduate Affairs Committee, the Materials Advantage faculty advisor, and is on the UT Undergraduate Research Advisory Committee. Her research interests include investigations of crystal structures, phase transitions, and thermophysical properties of a variety of materials using in-situ X-ray and neutron scattering methods. Rawn was in the PI and site director of the UT site of the Manufacturing and Materials Joining Innovation Center (Ma2JIC), funded by the National Science Foundation (NSF) Division of Industrial Innovations and Partnerships (IIP) and individual industrial memberships. Rawn received her bachelor’s in materials engineering from Virginia Polytechnic Institute and State University, her master’s in chemistry from George Mason University, and her doctorate in materials science and engineering from the University of Arizona.

Chris Wetteland  
Associate Director of Industrial Relationships and Undergraduate Research

Chris Wetteland has been the associate director for industrial relations and undergraduate research since 2017. Wetteland is an associate professor of practice in MSE at UT where he teaches laboratory coursework and senior design. His research interests include radiation damage in nuclear materials, ceramic processing, solar energy, ion beam analysis, advanced manufacturing, early solar system processes, and STEM outreach. He received his bachelor’s in geology from Northeastern Illinois University, his master’s in ceramics and materials engineering from Rutgers, and his doctorate in earth and planetary sciences from UT. Wetteland previously worked at Los Alamos National Laboratory as a staff member from 1997–2006, where his primary research was in ion beam analysis and radiation damage in materials. From 2010–2013, he was a research fellow at the University of Wisconsin-Madison, where he investigated accelerated aging of nuclear materials using particle accelerators.

Amber White  
Administrative Specialist

Amber White has served as the administrative specialist for CMP since 2016. Before joining UT, she spent five years in the social work sector, specializing in low-income senior housing and food housing regulations.

Karen Boyce  
Financial Specialist

Karen Boyce is the financial specialist for CMP. She has been working within various university systems since 1995 and joined UT in 2011.

Gerald Egeland  
Student Supervisor

Gerald Egeland is the CMP student supervisor and works with the undergraduate students on CMP Industrial Membership sponsored research. He has a joint appointment with MSE, serving as the undergraduate laboratory manager and the departmental safety officer. Egeland graduated with his bachelor’s in materials science and engineering in 1997, his master’s in 2006, and his doctorate in materials science in 2001 from New Mexico Institute of Mining and Technology. His graduate work focused on biomimetic materials, carbon nanotubes, microscale fuel and radiation damage characterization and was performed at Los Alamos National Laboratory. After obtaining his doctorate degree, he was a postdoctoral research associate at the Paul Scherrer Institute in Switzerland before transferring to Idaho National Lab, and eventually the University Nevada, Las Vegas (UNLV). His personal research has included working on radiation damage of alloys, ceramic powder processing for advanced fuel, and fuel-cladding interactions. Over the years in his various capacities, Egeland has supervised students and technicians and began teaching while at UNLV, producing and teaching a graduate SEM course. He also taught chemistry part time at both Nevada State College and the College of Southern Nevada.
Forging Ahead

By Meghan McDonald

Founded by a University of Tennessee meteorologist in 1902, Fulton is now a world-leading producer of seamless bellows. Over the past year, this company has forged a partnership with the CMP that reconnects them with their history and creates new opportunities in a business centered on an ancient technology.

Greg Canada joined Fulton Bellows as vice president and general manager last year, shortly after the partnership became official. “I wish I could take credit for it,” he said. “The goal is to leverage our combined strengths. We provide real-life industrial exposure to these students. They look at this old type of technology—belows—and evaluate our processes with incredibly high-tech equipment.”

Fulton faces an industry-wide challenge: new products are rarely designed with old technologies. And in the vertical Fulton serves, like aerospace, automotive, and oil and gas, there are always new products being introduced.

In the spring of 2019, Fulton was acquired by Smiths Group plc, which set about investing in new equipment and improving safety and quality standards. Canada has been tasked with “forging new territories” in which Fulton can compete outside of their traditional bellows market.

Last year, Fulton hosted a student for the first time through their CMP partnership. This academic year, Manufacturing Engineer Manager Kelly Ferguson will be more involved in directing the projects Fulton assigns to students. “Students bring fresh new ideas to the table that we may not see. They’re exposed to newer technologies. I think there’s a good future for this program here,” Ferguson said.

Fulton and CMP have established a cadence of communication that furthers their partnership. “They stay very in step with what we’re trying to do. We’ve discovered similar to CMP remain very expensive for these manufacturers. Other resources need and seeks to provide only solutions that help those companies save money, increase sales, or otherwise benefit economically. Other resources available otherwise,” Aslinger said. The affordable price of the entry-level CMP is also a draw. “Eighty percent of the companies we serve are looking for talent,” Aslinger said. “The goal is to leverage our combined strengths. We provide real-life industrial exposure to these students. They look at this old type of technology—belows—and evaluate our processes with incredibly high-tech equipment.”

Fulton creates a project or “wish list” to help professors understand what they need with their history and creates new opportunities in a business centered on an ancient technology. We provide real-life industrial exposure to these students. They look at this old type of technology—belows—and evaluate our processes with incredibly high-tech equipment.”

Fulton and CMP have established a cadence of communication that furthers their partnership. “They stay very in step with what we’re trying to do. We’ve discovered similar to CMP remain very expensive for these manufacturers. Other resources need and seeks to provide only solutions that help those companies save money, increase sales, or otherwise benefit economically. Other resources available otherwise,” Aslinger said. The affordable price of the entry-level CMP is also a draw. “Eighty percent of the companies we serve are looking for talent,” Aslinger said. “The goal is to leverage our combined strengths. We provide real-life industrial exposure to these students. They look at this old type of technology—belows—and evaluate our processes with incredibly high-tech equipment.”

Fulton creates a project or “wish list” to help professors understand what they need with their history and creates new opportunities in a business centered on an ancient technology. We provide real-life industrial exposure to these students. They look at this old type of technology—belows—and evaluate our processes with incredibly high-tech equipment.”

Fulton and CMP have established a cadence of communication that furthers their partnership. “They stay very in step with what we’re trying to do. We’ve discovered

Problem Solving Power

By Meghan McDonald

The Center for Industrial Services (CIS) specializes in problem solving for small to medium, locally owned and operated manufacturing companies. As part of the UT system and a member of the nationwide Manufacturing Extension Partnership, CIS is always looking for new resources within these networks to help them serve their clients. In 2019, George Aslinger, Bill Hicks, and other CIS solutions consultants toured the CMP facility. They immediately recognized the potential.

“Partnering with CMP,” Hicks said, “has given us a new and powerful problem-solving tool to bring to our clients. In their roles at CIS, Hicks and Aslinger match manufacturers with resources that fit their specific business problems. All CIS solutions consultants have real-world manufacturing experience.”

“We’re practitioners, not an academic unit,” Hicks said. “We understand the pain our clients feel when they can’t get the resources they need.”

CIS clients typically employ 50 people or fewer and lack the funds to access cutting-edge equipment and facilities. “When we toured the CMP facility and saw the capabilities there,” Aslinger said, “I got excited about the opportunities to help manufacturers craft answers to questions that manufacturing companies are asking. The hands-on work we do with our clients allows us to provide meaningful answers to real-world problems.”

In 2019, George Aslinger, Bill Hicks, and other CIS solutions consultants toured the CMP facility. They immediately recognized the potential.

“Partnering with CMP,” Hicks said, “has given us a new and powerful problem-solving tool to bring to our clients. In their roles at CIS, Hicks and Aslinger match manufacturers with resources that fit their specific business problems. All CIS solutions consultants have real-world manufacturing experience.”

“We’re practitioners, not an academic unit,” Hicks said. “We understand the pain our clients feel when they can’t get the resources they need.”

CIS clients typically employ 50 people or fewer and lack the funds to access cutting-edge equipment and facilities. “When we toured the CMP facility and saw the capabilities there,” Aslinger said, “I got excited about the opportunities to help manufacturers craft answers to questions that manufacturing companies are asking. The hands-on work we do with our clients allows us to provide meaningful answers to real-world problems.”

In 2019, George Aslinger, Bill Hicks, and other CIS solutions consultants toured the CMP facility. They immediately recognized the potential.

“Partnering with CMP,” Hicks said, “has given us a new and powerful problem-solving tool to bring to our clients. In their roles at CIS, Hicks and Aslinger match manufacturers with resources that fit their specific business problems. All CIS solutions consultants have real-world manufacturing experience.”

“We’re practitioners, not an academic unit,” Hicks said. “We understand the pain our clients feel when they can’t get the resources they need.”

CIS clients typically employ 50 people or fewer and lack the funds to access cutting-edge equipment and facilities. “When we toured the CMP facility and saw the capabilities there,” Aslinger said, “I got excited about the opportunities to help manufacturers craft answers to questions that manufacturing companies are asking. The hands-on work we do with our clients allows us to provide meaningful answers to real-world problems.”
In the last year, CMP has supported twelve graduate students, the majority of whom received funding through its competitive application process. These students, along with students supported by industrial memberships and contracts affiliated with CMP, are featured here.

John Bohling

John Bohling earned both his bachelor’s and master’s degrees in material science from U2 and is currently a Ph.D. candidate working with the Materials Joining Group (MJG) under the direction of Professor Emeritus Carl Lundin. The focus of Bohling’s research has centered around microstructural changes and properties that occur in metals as a result of welding and heat treatment, primarily focusing on nickel-based alloys and low-alloy steels. The choice of weldable materials, specific welding parameters, and heat treatment conditions can dramatically alter properties such as strength, toughness, creep performance, and corrosion resistance of industrial steels.

Bohling’s research has concentrated on understanding the relationship between processing and resulting material properties for the successful fabrication of steel structures and prevention or mitigation of welding-related problems. The Cr-Mo steels that he has primarily focused on are widely used in the power generation and petrochemical industries (for steam piping in power plants and oil refineries, for example). In welded Cr-Mo steam piping, the high temperatures lead to creep void formation in specific regions such as the coarse and fine-grain regions of the base material and weld-affected zones (HAZ), which can eventually result in premature failure.

Understanding how creep damage occurs in Cr-Mo steels is important for determining when existing steam piping must be repaired or replaced and also for developing in Cr-Mo weldments is important for understanding the relationship between microstructural characterization of creep-damaged, submicrostructure of the HAZ, and fine-grain regions of the base metal weld formation in specific regions such as the coarse and fine-grain regions of the base metal weld (for example).

How is materials processing involved in your research?

I assembled a hydra-dehydrate synthesis lab, which is included in the JIAM ceramics laboratory, to synthesize gas hydrate powders at the required high pressure and high temperature for obtaining higher efficiencies and longer service life.

Bohling has been involved in specific projects including microstructural characterization of creep-damaged, submicrostructure of the HAZ, and fine-grain regions of the base metal weld formation in specific regions such as the coarse and fine-grain regions of the base metal weld (for example).

How is materials processing involved in your research?

In collaboration with industry, Bohling uses specialized microstructural simulation equipment (Gleeble) for hot ductility testing together with specialized microstructural simulation equipment to evaluate the HAZ-formation cracking susceptibility of high and high temperature materials. Bohling has also served as a teaching assistant in several undergraduate classes including welding metallurgy, materials processing, materials selection in design, and materials selection. Bohling has also been recognized with both the MSE Graduate Student Award for Excellence in Service and Excellence in Teaching.

What is your thesis topic?

Investigation of Cr-Mo CO2 hydrate structure and dynamics with neutron scattering experiments and complementary simulations.

Bernadette Claudek

How is materials processing involved in your research?

Investigation of Cr-Mo CO2 hydrate structure and dynamics with neutron scattering experiments and complementary simulations.

What is your thesis topic?

Investigation of Cr-Mo CO2 hydrate structure and dynamics with neutron scattering experiments and complementary simulations.

Kate Higgins

How is materials processing involved in your research?

To create combinatorial libraries of custom hybrid organic-inorganic perovskite systems, I utilize a robotic pipetting robot, commonly used in the JIAM ceramics laboratory, to synthesize MHP samples with desired properties, including microstructure, thermal stability, and the crystallization of polycrystalline MHPs. In addition, numerous sample cleaning methods are also often used before characterizing MHPs’ properties to suppress false signals induced by contamination.

What is your thesis topic?

Utilization of automated combinatorial methods to identify new hybrid organic-inorganic perovskite compositions.

Yongtao Liu

What is your thesis topic?

Despite the impressive photovoltaic performance delivered by MHPs in the past decade, poor stability of MHPs hinders the practical applications of MHPs in solar cells. My research on understanding the effects on the photovoltaic performance of MHPs could be able to determine which hybrid organic-inorganic perovskites have the best stability.

How is materials processing involved in your research?

The focus of my research is to explore ion migration and ferroic behavior in metal halide perovskites (MHPs), as well as to understand their effects on the photovoltaic properties of MHPs.

What is your thesis topic?

Utilization of automated combinatorial methods to identify new hybrid organic-inorganic perovskite compositions.

What is your thesis topic?

The focus of my research is to explore ion migration and ferroic behavior in metal halide perovskites (MHPs), as well as to understand their effects on the photovoltaic properties of MHPs.
What is your thesis topic?

My thesis topic focuses on the spin effects of excited states in organic semiconductors.

Robert Minneci

What is your thesis topic?

My thesis topic is on the characterization and high-temperature synthesis of materials based on copper告知 that CSPA is developing for use in future spacecraft with additive manufacturing. My efforts are focused on adding the characterization efforts that NASA has already done, using neutron diffraction to learn information obtainable otherwise.

How is materials processing involved in your research?

How is materials processing involved in your research?

Materials processing is the core of my research. GRCop-84 is a Ni-base high heat power superalloy used without the unique processing advantages provided by additive manufacturing. GRCop-84 is a thermal and mechanical property of the best available, but its high melting and machining costs have limited its use to a small set of applications. The advantage of processing this material offers a unique research opportunity. Through metallography and neutron diffraction, I am investigating the development of thermal residual stress, evolution of the microstructure from powder to final part, and mechanical load shifting between the phases, all of which are directly correlated to processing.

Provide an example of where the material, process, or properties you are studying might find an application.

Provide an example of where the material, process, or properties you are studying might find an application.

The high-quality materials/devices have the foundation of my research. I prepare organic and perovskite materials on a silicon platform is highly lucrative as it is an enabling platform for advancing plasmonic devices with incredibly high detection efficiencies. The possibility of attaining superconductivity on these surfaces is decorated with electron-donating molecules. These surfaces are decorated with electron-donating alkali-alkalides or electron-accepting molecules.

Grace Pakeltis

What is your thesis topic?

What is your thesis topic?

My thesis topic is on the basic science side of things in my current research. How is materials processing involved in your research?

Uranium dioxide does not inherently meet the electrical properties necessary to effectively function as a semiconductor material in a solid-state neutron detector. Materials have been studied in ion-implanted single crystal samples that have been subjected to neutron irradiation. Cerium dioxide has also been used as a non-evaporoperative surrogate to study material processing methods of improving electrical properties. How is materials processing involved in your research?

How is materials processing involved in your research?

Future space craft with additive manufacturing will likely use neutron detection to keep an eye on the processing and microstructure and electrical properties. Selected dopant materials can directly impact the electrical properties necessary to effectively function as a semiconducting material in a solid-state neutron detector. Materials have been studied in ion-implanted single crystal samples that have been subjected to neutron irradiation. Cerium dioxide has also been used as a non-evaporoperative surrogate to study material processing methods of improving electrical properties.

Provide an example of where the material, process, or properties you are studying might find an application.

Provide an example of where the material, process, or properties you are studying might find an application.

How is materials processing involved in your research?

What is your thesis topic?

My thesis topic is on the basic science side of things in my current research. How is materials processing involved in your research?

Uranium dioxide does not inherently meet the electrical properties necessary to effectively function as a semiconductor material in a solid-state neutron detector. Materials have been studied in ion-implanted single crystal samples that have been subjected to neutron irradiation. Cerium dioxide has also been used as a non-evaporoperative surrogate to study material processing methods of improving electrical properties.

How is materials processing involved in your research?

Uranium dioxide does not inherently meet the electrical properties necessary to effectively function as a semiconductor material in a solid-state neutron detector. Materials have been studied in ion-implanted single crystal samples that have been subjected to neutron irradiation. Cerium dioxide has also been used as a non-evaporoperative surrogate to study material processing methods of improving electrical properties.
Friction stir welding has been applied in many processes, or properties you are studying might provide us a better understanding of the fundamental thermomechanical processes. My efforts are focused on investigating how materials processing involves in your research? friction stir welding is a quintessential solid-state-material processing technique. The realization of pseudospin-1/2 iridate systems requires state-of-the-art synthesis methods, and advanced characterization techniques are necessary to find an application. In the friction stir welding process and providing analytical and computational mechanics models to describe the solid-state bonding in severe thermomechanical processes. Provide an example of where the material, process, or properties you are studying might find an application.

Friction stir welding has been applied in many fields, such as aerospace, automotive and railway. The structure integrity of the weldment will depend on the solid-state bonding condition at the weld interface, which is controlled by processing parameters. Numerical simulation could help to get a better understanding of the dependence of bonding evolution on processing parameters and materials behavior, which will help to novel design strategies in promoting the quality of the weldment.

Junyi Yang

What is your thesis topic? My thesis topic is on predictive microstructural modeling and welding behavior, which will help to reveal design strategies in evolution on processing parameters and materials behavior, which will help to novel design strategies in promoting the quality of the weldment.

What is your research? How is materials processing involved in your research? Fusion welding, friction stir welding shows several advantages compared with traditional fusion welding, friction stir welding shows several superiorities and has been widely used for joining of metal materials. Friction stir welding is a fusion welding process that produces welds by rotating a tool that has a shoulder and a pin or a probe; a rotating tool with a flat shoulder and a conical pin that forces workpiece material to flow and solidifies into a weld. This study will provide us a better understanding of the fundamental thermomechanical processes. My main objective is to study the mechanical behavior of iridate heterostructures achieved by atomically controlled layer-by-layer growth technique.

Motivation for your research? Through measurements like X-ray diffraction, one can accurately know the structural distortion and deformation induced by epitaxial strain. Combined with advanced characterization techniques, such as X-ray diffraction, one is able to control the strength of magnetization and ordering temperature. This can be used as a switch where the on and off of magnetic ordering is controlled by an external magnetic field.

"Junyi is the best graduate student in my group, making great impact to our research far beyond his own project, including maintenance of our growth system during this difficult time." — Jian Lin, Assistant Professor Department of Physics and Astronomy

Thesis/Dissertation Titles

Amanda Hagnud
PhD, Summer 2019 Dissertation: "Thermal Conductivity of MX3Y-Layered Magnetic Semiconductors" Advisor: David Mandrus

Anita Hoffman
PhD, Summer 2019 Dissertation: "Correlating the Effects of Aging and Oregon Plasma Treatment to the Electrical Properties of W6%2 and Pibiz" Advisor: Philip Riek

Changbo Lee
PhD, Fall 2019 Dissertation: "Design and Development of Strong and Durable Single B/C Refractory High-entropy Alloys for High-temperature Applications" Advisor: Peter Liao

Matt Loyd
PhD, Summer 2019 Dissertation: "Investigation of Environmental Degradation of Plastic Scintillators" Advisor: Maya Zhuravleva

Ling Wang
PhD, Fall 2019 Dissertation: "Phase Stability of Precipitates After Ion Irradiation and Creep Deformation" Advisor: Steven Zinkle

Youxiang Ye
PhD, Fall 2019 Dissertation: "Mechanical Behavior of Body-Centered Cubic High-Entropy Alloys" Advisor: T.G. Langdon

Sabrina McCoy
MS, Spring 2020 Thesis: "Synthesis and Structural Characterization of CuIn2O3" Advisor: Claudia Rowen

Xue Wang

What is your thesis topic? My thesis topic is on predictive microstructural modeling and welding behavior, which will help to reveal design strategies in evolution on processing parameters and materials behavior, which will help to novel design strategies in promoting the quality of the weldment.

What is your research? How is materials processing involved in your research? Fusion welding, friction stir welding shows several advantages compared with traditional fusion welding, friction stir welding shows several superiorities and has been widely used for joining of metal materials. Friction stir welding is a fusion welding process that produces welds by rotating a tool that has a shoulder and a pin or a probe; a rotating tool with a flat shoulder and a conical pin that forces workpiece material to flow and solidifies into a weld. This study will provide us a better understanding of the fundamental thermomechanical processes. My main objective is to study the mechanical behavior of iridate heterostructures achieved by atomically controlled layer-by-layer growth technique.

Motivation for your research? Through measurements like X-ray diffraction, one can accurately know the structural distortion and deformation induced by epitaxial strain. Combined with advanced characterization techniques, such as X-ray diffraction, one is able to control the strength of magnetization and ordering temperature. This can be used as a switch where the on and off of magnetic ordering is controlled by an external magnetic field.

"Junyi is the best graduate student in my group, making great impact to our research far beyond his own project, including maintenance of our growth system during this difficult time." — Jian Lin, Assistant Professor Department of Physics and Astronomy

Thesis/Dissertation Titles

Amanda Hagnud
PhD, Summer 2019 Dissertation: "Thermal Conductivity of MX3Y-Layered Magnetic Semiconductors" Advisor: David Mandrus

Anita Hoffman
PhD, Summer 2019 Dissertation: "Correlating the Effects of Aging and Oregon Plasma Treatment to the Electrical Properties of W6%2 and Pibiz" Advisor: Philip Riek

Changbo Lee
PhD, Fall 2019 Dissertation: "Design and Development of Strong and Durable Single B/C Refractory High-entropy Alloys for High-temperature Applications" Advisor: Peter Liao

Matt Loyd
PhD, Summer 2019 Dissertation: "Investigation of Environmental Degradation of Plastic Scintillators" Advisor: Maya Zhuravleva

Ling Wang
PhD, Fall 2019 Dissertation: "Phase Stability of Precipitates After Ion Irradiation and Creep Deformation" Advisor: Steven Zinkle

Youxiang Ye
PhD, Fall 2019 Dissertation: "Mechanical Behavior of Body-Centered Cubic High-Entropy Alloys" Advisor: T.G. Langdon
Jared Floyd

Jared Floyd graduated in May with a bachelor’s degree in materials science and engineering. Floyd was born in Mt. Pleasant, North Carolina, where he became an Eagle Scout at thirteen and participated in his high school marching band and symphonic band. After September 11, Floyd enlisted into the United States Air Force and upon graduating high school, went to the country with a degree in a University Division and bagged for three months. He then attended basic training in San Antonio, Texas, and his first duty assignment was at Pope Air Force Base in North Carolina. After seven years, he deployed to Bagram Air Base in Afghanistan as part of Operation Enduring Freedom. Floyd was reassigned to Shaw Air Force Base in South Carolina in early 2005. He also deployed to Oman Air Force Base in South Korea for six months. In September 2014, he deployed to Mt. Pleasant, North Carolina, where he became an Eagle Scout at thirteen and graduated high school, he toured the country with a University Division and bagged for three months. He then attended basic training in San Antonio, Texas, and his first duty assignment was at Pope Air Force Base in North Carolina. After seven years, he deployed to Bagram Air Base in Afghanistan as part of Operation Enduring Freedom. Floyd was reassigned to Shaw Air Force Base in South Carolina in early 2005. He also deployed to Oman Air Force Base in South Korea for six months. In September 2014, he deployed to Mt. Pleasant, North Carolina, where he became an Eagle Scout at thirteen and attended basic training in San Antonio, Texas, and his first duty assignment was at Pope Air Force Base in North Carolina. After seven years, he deployed to Bagram Air Base in Afghanistan as part of Operation Enduring Freedom. Floyd was reassigned to Shaw Air Force Base in South Carolina in early 2005. He also deployed to Oman Air Force Base in South Korea for six months. In September 2014, he deployed to Mt. Pleasant, North Carolina, where he became an Eagle Scout at thirteen and attended basic training in San Antonio, Texas, and his first duty assignment was at Pope Air Force Base in North Carolina. After seven years, he deployed to Bagram Air Base in Afghanistan as part of Operation Enduring Freedom.

Cale Overstreet

Cale Overstreet is a junior studying nuclear engineering and conducting research under Associate Professor Brian Long. Prior to studying UC, he feels a direct influence from these mentors on making him a better researcher and helping him reach his goals of earning his PhD and eventually conducting research in advanced materials for energy sustainability at a national laboratory or university. Specifically, I study the laser powder-bed fusion technique using high resolution tomographic tomography and radiography,” he said. “The goal is to develop a better understanding of this process so it may be incorporated into industrial applications.” White said the Goldwater Scholarship will help him further his research path and allow him to attend conferences that may have otherwise been out of his budget.

Nicholas Legaux

Nicholas Legaux is studying chemical engineering and conducting research with Associate Professor Brian Long. Prior to studying UC, Long has made poster presentations at EUReCA and Logan White were named 2020 Goldwater Scholars, earning the most prestigious undergraduate STEM scholarship awarded in the United States.

Logan White

Logan White's focus in MSE has been within the field of additive manufacturing. "Specifically, I study the laser powder-bed fusion technique using high resolution tomographic tomography and radiography,” he said. “The goal is to develop a better understanding of this process so it may be incorporated into industrial applications.” White said the Goldwater Scholarship will help him further his research path and allow him to attend conferences that may have otherwise been out of his budget.

Samantha Maness

Samantha Maness describes the award as an incredible feeling of recognition for her hard work in class and in research. “It really drives home to me the fact that the work I’m involved in matters outside of my immediate academic sphere,” she added. “The experience of applying for this award not only bolstered my future alongside the way, but also helped me to continue my research and my personal growth as a female scientist.” Maness’s scholarship-worthy research has been to conduct research on novel metal composite materials for use in advanced manufacturing. "While Legaux has proven he is adept at researching and conducting research under Associate Professor Cale Overstreet is a junior studying nuclear engineering and conducting research under Associate Professor Brian Long. Prior to studying UC, he feels a direct influence from these mentors on making him a better researcher and helping him reach his goals of earning his PhD and eventually conducting research in advanced materials for energy sustainability at a national laboratory or university. Specifically, I study the laser powder-bed fusion technique using high resolution tomographic tomography and radiography,” he said. “The goal is to develop a better understanding of this process so it may be incorporated into industrial applications.” White said the Goldwater Scholarship will help him further his research path and allow him to attend conferences that may have otherwise been out of his budget.

Cale Overstreet

Cale Overstreet is a junior studying nuclear engineering and conducting research under Associate Professor Brian Long. Prior to studying UC, he feels a direct influence from these mentors on making him a better researcher and helping him reach his goals of earning his PhD and eventually conducting research in advanced materials for energy sustainability at a national laboratory or university. Specifically, I study the laser powder-bed fusion technique using high resolution tomographic tomography and radiography,” he said. “The goal is to develop a better understanding of this process so it may be incorporated into industrial applications.” White said the Goldwater Scholarship will help him further his research path and allow him to attend conferences that may have otherwise been out of his budget.

Nicholas Legaux

Nicholas Legaux is studying chemical engineering and conducting research with Associate Professor Brian Long. Prior to studying UC, Long has made poster presentations at EUReCA and Logan White were named 2020 Goldwater Scholars, earning the most prestigious undergraduate STEM scholarship awarded in the United States.

Logan White

Logan White's focus in MSE has been within the field of additive manufacturing. "Specifically, I study the laser powder-bed fusion technique using high resolution tomographic tomography and radiography,” he said. “The goal is to develop a better understanding of this process so it may be incorporated into industrial applications.” White said the Goldwater Scholarship will help him further his research path and allow him to attend conferences that may have otherwise been out of his budget.

Samantha Maness describes the award as an incredible feeling of recognition for her hard work in class and in research. “It really drives home to me the fact that the work I’m involved in matters outside of my immediate academic sphere,” she added. “The experience of applying for this award not only bolstered my future alongside the way, but also helped me to continue my research and my personal growth as a female scientist.” Maness’s scholarship-worthy research has been to conduct research on novel metal composite materials for use in advanced manufacturing. "While Legaux has proven he is adept at researching and conducting research under Associate Professor Cale Overstreet is a junior studying nuclear engineering and conducting research under Associate Professor Brian Long. Prior to studying UC, he feels a direct influence from these mentors on making him a better researcher and helping him reach his goals of earning his PhD and eventually conducting research in advanced materials for energy sustainability at a national laboratory or university. Specifically, I study the laser powder-bed fusion technique using high resolution tomographic tomography and radiography,” he said. “The goal is to develop a better understanding of this process so it may be incorporated into industrial applications.” White said the Goldwater Scholarship will help him further his research path and allow him to attend conferences that may have otherwise been out of his budget.

Cale Overstreet

Cale Overstreet is a junior studying nuclear engineering and conducting research under Associate Professor Brian Long. Prior to studying UC, he feels a direct influence from these mentors on making him a better researcher and helping him reach his goals of earning his PhD and eventually conducting research in advanced materials for energy sustainability at a national laboratory or university. Specifically, I study the laser powder-bed fusion technique using high resolution tomographic tomography and radiography,” he said. “The goal is to develop a better understanding of this process so it may be incorporated into industrial applications.” White said the Goldwater Scholarship will help him further his research path and allow him to attend conferences that may have otherwise been out of his budget.
Unlocking Potential... By Meghan McDonald. By Meghan McDonald.

It’s difficult to predict the desired properties using computational methods,” Zhuravleva said, “proposing new crystal structures with specific properties and metrics is a vital part of two peer-reviewed papers led by graduate student Matheus Pianassola last spring.

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“When you take advantage of one opportunity,” Loveday said, “they start snowballing. You get to see and do even more things. I’m very grateful for opportunities CMP has given me—the job, the conference, for letting me experience these things.”

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“When you take advantage of one opportunity,” Loveday said, “they start snowballing. You get to see and do even more things. I’m very grateful for opportunities CMP has given me—the job, the conference, for letting me experience these things.”

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“When you take advantage of one opportunity,” Loveday said, “they start snowballing. You get to see and do even more things. I’m very grateful for opportunities CMP has given me—the job, the conference, for letting me experience these things.”

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“When you take advantage of one opportunity,” Loveday said, “they start snowballing. You get to see and do even more things. I’m very grateful for opportunities CMP has given me—the job, the conference, for letting me experience these things.”

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“When you take advantage of one opportunity,” Loveday said, “they start snowballing. You get to see and do even more things. I’m very grateful for opportunities CMP has given me—the job, the conference, for letting me experience these things.”

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“When you take advantage of one opportunity,” Loveday said, “they start snowballing. You get to see and do even more things. I’m very grateful for opportunities CMP has given me—the job, the conference, for letting me experience these things.”

“Crystals are everywhere,” Assistant Professor Mariya Zhuravleva will tell you. “Look at your phone, your computer, your car.”

When they started, they didn’t have exposure to research,” Jothi said. “Now, I can tell them how to do that.”

“When you take advantage of one opportunity,” Loveday said, “they start snowballing. You get to see and do even more things. I’m very grateful for opportunities CMP has given me—the job, the conference, for letting me experience these things.”
The Center for Materials Processing

Program Overview and Accomplishments

By Claudia Rawn.

The technical accomplishments of CMP are attributed to the associated graduate students, undergraduate students, and faculty that the CMP supports. Support comes in a variety of ways, including graduate assistantships, paid undergraduate research, undergraduate scholarships, funds for buying state of the art instruments housed in core facilities, travel support for students, smaller-scale instrument purchases, and the cost of large-scale instruments.

In past years, the majority of CMP funds go directly to supporting the stipends of graduate students, hourly wages for undergraduate students, and salary support for CMP administrative and technical activities. This year, however, the percentage of funds used to support equipment increased so much over previous years was pooled to replace the bench top scanning electron microscope, which is used by countless students during recruitment activities, academic laboratories, and sponsored research.

Chris Wetland continued in his role as CMP’s Director of Industry Relations and undergraduate research. His duties include working with representatives from the Center for Industrial Services (CIS) and other local industry partners, both individually and as part of core facility industrial memberships and continuing previously established relationships.

David Rago and Eygabord jointly supported by CMP and MSIE, came on board to help support Wetland in overseeing CMP equipment and students that support research for these facility-level memberships.

CMP supports industry through technical consults, performing research/characterization in the areas of materials processing, and identifying new and industry partners to leverage our advanced microscopy techniques, thinning of PdSe2 flakes for field effect transistors.

In FY20, CMP continued the competitive process for covering travel to a professional conference for students financially in presenting their research at the Materials Science & Technology Technical Meeting and Exhibition (MS&T19) and the TMS Annual Meeting and Exhibition (TMS19). Top posters are recognized with travel support, which allows student winners to attend professional meetings and conferences of the Oak Ridge Chapter of ASM and the American Association of Crystal Growers, Southeast Section (AACG-SE). Top posters are recognized with travel support, which allows student winners to attend professional meetings and present their research. These travel awards act as a way of disseminating the outstanding research by UT students to a larger community. In FY20, CMP assisted students financially in presenting at the Materials Science & Technology Technical Meeting and Exhibition (MS&T19) and the TMS Annual Meeting and Exhibition in San Diego.

There were countless students during recruitment activities, from previous years was pooled to replace the bench top scanning electron microscope, which is used by countless students during recruitment activities, academic laboratories, and sponsored research.

In FY20, Gerald Egeland, jointly supported by CMP and ORNL, Y-12, and the National Nuclear Security Administration in Washington, DC.

By Claudia Rawn.

The technical accomplishments of CMP are attributed to the associated graduate students, undergraduate students, and faculty that the CMP supports. Support comes in a variety of ways, including graduate assistantships, paid undergraduate research, undergraduate scholarships, funds for buying state of the art instruments housed in core facilities, travel support for students, smaller-scale instrument purchases, and the cost of large-scale instruments.

In past years, the majority of CMP funds go directly to supporting the stipends of graduate students, hourly wages for undergraduate students, and salary support for CMP administrative and technical activities. This year, however, the percentage of funds used to support equipment increased so much over previous years was pooled to replace the bench top scanning electron microscope, which is used by countless students during recruitment activities, academic laboratories, and sponsored research.

Chris Wetland continued in his role as CMP’s Director of Industry Relations and undergraduate research. His duties include working with representatives from the Center for Industrial Services (CIS) and other local industry partners, both individually and as part of core facility industrial memberships and continuing previously established relationships.

David Rago and Eygabord jointly supported by CMP and MSIE, came on board to help support Wetland in overseeing CMP equipment and students that support research for these facility-level memberships.

CMP supports industry through technical consults, performing research/characterization in the areas of materials processing, and identifying new and industry partners to leverage our advanced microscopy techniques, thinning of PdSe2 flakes for field effect transistors.

In FY20, CMP continued the competitive process for covering travel to a professional conference for students financially in presenting their research at the Materials Science & Technology Technical Meeting and Exhibition (MS&T19) and the TMS Annual Meeting and Exhibition (TMS19). Top posters are recognized with travel support, which allows student winners to attend professional meetings and conferences of the Oak Ridge Chapter of ASM and the American Association of Crystal Growers, Southeast Section (AACG-SE). Top posters are recognized with travel support, which allows student winners to attend professional meetings and present their research. These travel awards act as a way of disseminating the outstanding research by UT students to a larger community. In FY20, CMP assisted students financially in presenting at the Materials Science & Technology Technical Meeting and Exhibition (MS&T19) and the TMS Annual Meeting and Exhibition in San Diego.

9. CMP-supported students also earned various accolades in FY20. Camera Foster was chosen as the student speaker at the fall 2019 graduate hooding ceremony. Samantha Mannon, Jackson Spurlock, and Logan White, MSIE, students who received partial support from CMP, were honored with Goldwater Scholarships. Bernadette Chalek, Ian Greeley, and Chanho Lee, Collin Pekol, and Morgan Yount were all honored with receiving recognition from the Thomas D. Scott for Outstanding Professorial Promise. CMP-supported undergraduates farred well at the Exhibition of Undergraduate Research and Creative Achievement (EURACA) in April, with Kate Eikel, supervised by Professor Eric Wu, receiving first place and the team of Ryan Heldt and Logan White, supervised by Professor Hahn Choo, receiving third place in the engineering division. The winners then competed for recognition from the UT Office of Undergraduate Research (OUR), the event sponsor, with Eikel winning gold.

CMP awards full or partial travel support to students who have won local CMP-supported poster competitions, including one each in collaboration with the local chapters of the Oak Ridge Chapters of ASM and the American Association of Crystal Growers, Southeast Section (AACG-SE). The poster are recognized with travel support, which allows student winners to attend professional meetings and present their research. These travel awards act as a way of disseminating the outstanding research by UT students to a larger community. In FY20, CMP assisted students financially in presenting at the Exhibition of Undergraduate Research and Creative Achievement (EURACA) in April, with Kate Eikel, supervised by Professor Eric Wu, receiving first place and the team of Ryan Heldt and Logan White, supervised by Professor Hahn Choo, receiving third place in the engineering division. The winners then competed for recognition from the UT Office of Undergraduate Research (OUR), the event sponsor, with Eikel winning gold.
Participants at the CMP Winter Synthesis Workshop at JIAM in December 2019. The Center for Materials Processing (CMP) help partially support the purchase of new laboratory spaces in UT’s Science and Engineering Complex (SEC) with non-gravity aligned gas metal arc (GMAW) welding for power plant piping and pressure vessels. In June of 2020, UT virtually hosted the Manufacturing and Materials Joining Innovation Center (Ma2JIC) Advisory Board summer meeting and submitted joint proposal to the National Science Foundation for moving to Phase III.

In FY20, CMP helped partially support the purchase of a keyence digital microscope and tensile testing system capable of testing at atmospheric temperatures. The champions of these two research projects are Pribble Professor Dayakar Penumadu and MABE work closely with staff members at MDF, including traditional welding and friction stir welding (GMAW). In June of 2020, UT virtually hosted the summer IAB meeting with non-gravity aligned gas metal arc (GMAW) welding for power plant piping and pressure vessels. Six facility level memberships supporting local industry and strengthening the center’s involvement with industry partners. These plans will be supported by identifying, purchasing, maintaining, and supporting equipment and materials processing constituencies by increasing our industrial memberships while leveraging our CM Accomplishments

- Six facility level memberships supporting local industry
- Support packages for 14 graduate students
- Generated 25 publications
- Funded in more than 60 undergraduate students participating in research activities
- Maness, Spurling, White awarded Goldwater Scholarships
- Students competed in the CMP undergraduate poster competition and participated at the TMS annual meeting
- Structures in EUReCA
- Eikel: First (Engineering Division) and Gold (Office of Undergraduate Research award)
- Halin/White: Third (Engineering Division)

Future Goals and Plans

The overarching goal for CMP in FY21 is to support our materials processing constituencies by increasing our graduate student, under-graduate student, and industrial members. These plans will be supported by identifying, purchasing, maintaining, and supporting equipment and materials processing constituencies by increasing our industrial memberships while leveraging our

- Hosted Winter Synthesis Workshop
- Co-sponsored and co-hosted student night with 38 poster entries
- Re-established workshops benchtop scanning electron microscopy
- Virtually hosted the Manufacturing and Materials Joining Innovation Center (Ma2JIC) Advisory Board summer meeting and submitted joint proposal to the National Science Foundation for moving to Phase III.


