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NSF-PIRE-PDC NEWSLETTER

THE SOCIAL DISTANCING ISSUE

PDC WORKSHOP GOES VIRTUAL

Our first virtual workshop was held from August 17-20. Page 2

RESEARCH THROUGH THE PANDEMIC

The students have adapted to the situation and are conducting their research in innovative ways. Page 2.

WHAT'S BEEN HAPPENING?

The PDC community has been staying busy. Find out what our PDC partners around the globe are doing. Read about it on page 3.

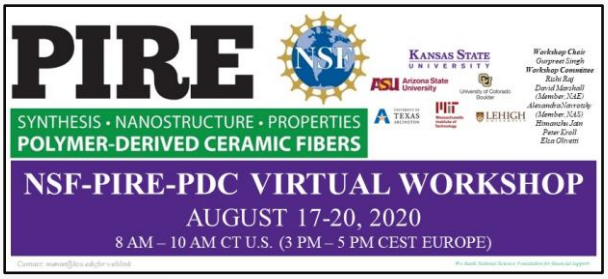
This year has been a steep learning curve for our Polymer Derived Ceramics (PDC) community. Despite the obstacles, we are working, learning, collaborating, and innovating. We are fortunate to have partners from academia and industry who share the same vision. Our students have risen to the challenge and shown us what they can accomplish.

Although there is camaraderie, I miss the social aspect of being part of this project. Technology has enabled us to work and stay connected through these tough times, yet meeting students, partners, and collaborators remotely has a very impersonal feel. I look forward to the day when we can resume meeting in person, rather than over Zoom.

-Prof. Gurpreet Singh, PIRE PI

PDC WORKSHOP GOES VIRTUAL

The third annual NSF-PIRE-PDC workshop was hosted August 17–20 in a virtual-only format due to the COVID-19 pandemic.



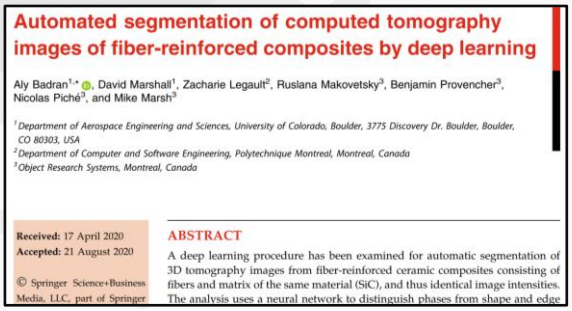
Many workshop registrants were from aero and defense industries, including Boeing, Spirit AeroSystems, HRL Laboratories, Starfire Systems, Raytheon United Technologies, and Sierra Turbines. In addition, scientists from the Air Force Research Laboratories and program officers of government funding agencies such as AFOSR and NSF attended the workshop to share their research findings and learn about the applications of ceramic matrix composites (CMC) materials, respectively. Faculty members and students from Brazil, France, Germany, India, Italy, Japan, and Spain presented their research.

The virtual workshop platform was a major draw to students, scientists, and engineers — nearly half the registrants were first-time participants, with twice the overall attendance numbers from previous workshops. The workshop also highlighted student research and accomplishments. Graduate students in the PIRE project showed most of the presentations on the first day of the workshop, while the last day was dedicated to undergraduate student presentations. A total of eight undergraduate students were part of the PIRE summer project.

"I expected a bigger turnout than the previous year, but the registration numbers from this year's workshop were astounding!", said **Dr. Gurpreet Singh**. "This just goes to show that many researchers are interested in our project, and that the field is growing. We are grateful for the opportunity to establish PDC research in the U.S. and collaborate with academia and industry across the globe."

STUDENT RESEARCH STAYS STRONG THROUGH THE PANDEMIC

The COVID-19 pandemic brought an unanticipated change in the way PIRE students have been conducting research. Most undergraduate students gained exposure to their summer research topics through scientific literature reviews, while a few conducted limited research in laboratory settings. Although most undergraduate students did not have extensive hands-on training in laboratory settings, they gained an in-depth theoretical knowledge of their research project. Because some participating undergraduate students plan to return to the PIRE project next summer for research abroad experience, the groundwork for next summer's research has already been laid.


Automated segmentation of computed tomography images of fiber-reinforced composites by deep learning

Aly Badran[1,*], David Marshall[1], Zacharie Legault[2], Ruslana Makovetsky[3], Benjamin Provencher[3], Nicolas Piché[3], and Mike Marsh[3]

[1] Department of Aerospace Engineering and Sciences, University of Colorado, Boulder, 3775 Discovery Dr. Boulder, Boulder, CO 80303, USA
[2] Department of Computer and Software Engineering, Polytechnique Montreal, Montreal, Canada
[3] Object Research Systems, Montreal, Canada

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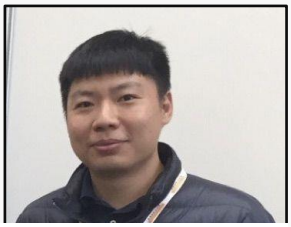
ABSTRACT

A deep learning procedure has been examined for automatic segmentation of 3D tomography images from fiber-reinforced ceramic composites consisting of fibers and matrix of the same material (SiC), and thus identical image intensities. The analysis uses a neural network to distinguish phases from shape and edge

Aly Badran's research article was published in the Journal of Materials science, in August.

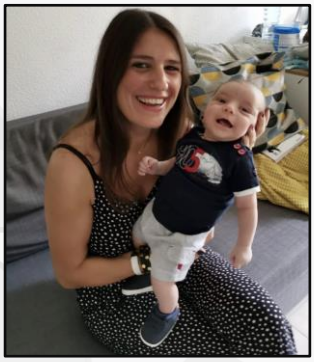
During the time away from the labs, the graduate students have been engaged in literature review and working on incomplete manuscripts. Some of the literature review being conducted has the potential to be converted into review articles. As the labs around the country have gradually reopened, the graduate students have had the opportunity to conduct experiments on a limited basis. The graduate and undergraduate students have been meeting with their domestic and international mentors via Zoom.



Zhongkan Ren successfully defended his PhD thesis in August

The pandemic may have put a dent in plans, but it has not stopped our students from accomplishing their goals. Zhongkan Ren, a PhD track student at Kansas State University, mentored by **Dr. Gurpreet Singh**, successfully defended his PhD thesis in August, titled "Organosilicon Polymer-Derived Ceramic Fibers: Fabrication and Molecular Structure Investigations". Casey Sugie, a Master's track student at University of California, Davis, mentored by **Dr. Alexandra Navrotsky**, successfully defended her Master's thesis, titled "A study of the structure and thermodynamics of amorphous silicon oxycarbide polymer-derived ceramics with and without mixed-bonding". Aly Badran, a PhD track student at the University of Colorado, Boulder, under the tutelage of **Drs. David Marshall** and **Rishi Raj**, recently published a research article in the Journal of Materials Science, titled "Automated segmentation of computed tomography images of fiber-reinforced composites by deep learning". Congratulations, Zhongkan, Casey, and Aly!

AND THEN THERE IS HAPPY NEWS!



Dr. Chrystelle Salameh and her husband Damien, have a new addition to their family. On July 30, Chrystelle gave birth to baby Jonas. Mom, Dad, and baby are all doing fine. As new parents, they are severely lacking in the sleep department; however, the joy of spending time with their baby more than makes up for the lack of sleep. We look forward to seeing baby Jonas in person when he accompanies Mom to her conferences. Congratulations Chrystelle and Damien, and welcome to the PDC family, baby Jonas!

UPDATES FROM THE PDC COMMUNITY

Prof. Alexandra Navrotsky created a seminar course titled "Thermodynamics Crash Course", which helped the incoming PIRE undergraduate summer scholars gain a deeper understanding of thermodynamics. Navrotsky has been elevated to Distinguished Life Membership of The American Ceramic Society (ACerS), the highest honor of the Society.

Prof. Gurpreet Singh joins the editorial team of the Journal of the American Ceramic Society as Associate Editor. Singh and his team were awarded a patent on work involving flexible silicon oxy-carbide based electrodes.

A very productive project mid-term review at the NSF. Image (L) Participants in front of the NSF building. Image (R)Thank you to NSF Program Officers, Maija Kukla (L) and Cassandra Dudka (R), for organizing this meeting.

Drs. Gurpreet Singh, Peter Kroll, Alexandra Navrotsky, Ralf Riedel, and **Jared Weaver**, and **Mr. Sailesh Menon** participated in the mid-term project review at the NSF headquarters in Alexandria, VA.

Prof. Peter Kroll and his group recently published an article in the Journal of Physical Chemistry titled "Computing the Tantalum−Nitrogen Phase Diagram at High Pressure and High Temperature".

Prof. Rishi Raj created a new course for incoming freshmen students titled "In the Footsteps of da Vinci". The course is designed to teach how science, technology, philosophy, and poetry come together.

Dr. Elsa Olivetti published a review article in Nature Magazine titled "Strategies for improving the sustainability of structural metals".

Drs. Philippe Miele and **Chrystelle Salameh** are guest editors for the special issue "Advanced Functional Polymer-Derived Ceramic Fibers: Preparation, Properties and Applications", in the journal Materials.

Dr. Ralf Riedel is the coordinator of an EU-Battery project which has received funding of €8 Million for 3.5 years. This project is slated to begin in 2021.

Drs. Gabriela Mera and **Isabel Gonzalo de Juan** were the main organizers of the Special Workshop "Women of Distinction in Materials Science".

Dr. Emanuel Ionescu published a research article in the Journal of the European Ceramic Society, on the high temperature oxidation behavior of HfC/SiC-based nanocomposites.

Dr. Samuel Bernard taught a course "Introduction to the Science and Technology Development of Polymer-Derived Ceramics", at Web'Tech #8.

Dr. Paolo Colombo is the Editor-in-Chief of Open Ceramics: a brand new, official, peer-reviewed, Open Access journal of the European Ceramic Society, published by Elsevier.

Prof. N. V. Ravi Kumar has been appointed as an Associate Editor of Advances in Materials Science and Engineering.

For most of us, this has been a roller coaster of a year. The one take away message from this pandemic, is that humans are a resilient species and can adapt to change much faster than we would like to give ourselves credit for. We may not be able to meet in person, but meetings occur regularly. There may not be physical conferences or workshops, but we host conferences and workshops with larger turnouts than in previous years. Parents are now multitasking between work and their child's education. We have all grown from this situation. With the hope of a vaccine round the corner, most of us are hopeful that there will be a sense of normalcy in the upcoming year. Looking to the future, we have secured our workshop venue for the 2021 workshop.

I am very grateful for this chance to be close to my family and the opportunity to get to know them better than I ever have. It is all the small things that make a big difference during these unprecedented times. Stay strong, stay safe, and we wish you a wonderful holiday season!

Sailesh Menon

Contact Information for P.I.:
Dr. Gurpreet Singh
Harold O. and Jane C. Massey Neff Professor,
Associate Professor,
Mechanical and Nuclear Engineering Department
3002 Rathbone Hall, Kansas State University,
Manhattan, Kansas 66506, USA
Phone: 785-532-7085
gurpreet@k-state.edu

Contact information for Project Coordinator/Administrator:
Mr. Sailesh Menon
Phone: 785-532-7024
menon@k-state.edu

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PIRE meeting at Daytona in Jan 2020. Pre COVID-19 days: No social distancing required for this one!

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