PUMRS

Materials Today

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Graduate Student Highlight

Junnan Hu, ECE, G5

- **Favorite material:** Perovskite
- **Hometown:** Chongqing, China
- **Undergraduate Institution:** Peking University
- **Research Interests and goals:** Junnan is a fifth year graduate student in the ECE department. He conducts research on perovskites and their photovoltaic properties in Professor Barry Rand's group. Perovskites are a class of highly versatile and vulnerable hybrid metal-organic materials. One challenge that Junnan is trying solve is the stability of perovskites. Perovskite-based photovoltaic devices made in the laboratories have less than 5-10 years of lifespan. The material is projected to achieve the same power conversion efficiency as traditional silicon-based photovoltaic devices at a much lower cost. Aside from high power conversion efficiencies and long-term stability, mature infrastructures and manufacturing technologies will be required for perovskite to replace silicon in the next few decades.
- **Why are you interested in your field?** For Junnan, working in the renewable energy sector and tackling the energy crisis have always been fascinating. Junnan has been working on perovskite research since he was an undergraduate student. The most exciting aspects of the field are the prospects of future perovskite materials and the role that photovoltaics play in combating climate change.
- **Favorite things about your lab:** Friendly lab culture and research interests
- **Post-graduation plans:** Deciding between applying for an industry job and a faculty position in academia
- **Advice for undergraduates:** If you are interested in PhD programs in the future, expand your scope of research to fully convince yourself that you are interested in a particular field.

- Z. Lin

Notes From the Editor:

Welcome to the fifth edition of the PUMRS newsletter, *Materials Today*! This is the first newsletter of AY 22-23. I am delighted to introduce a new member of the PUMRS newsletter committee, Colin Brown '23 from the CBE department!

We plan on continuing monthly release of *Materials Today*. In addition to materials science news and event highlights, we are dedicating a new section to showcase graduate students working on materials science related research. Future issues will include more graduate students who can share their graduate school paths, research interests, and valuable advice for undergraduates as well as research done by PRISM affiliated professors!

This semester, PUMRS is planning several exciting events. The annual Blacksmith event will be held on Saturday, October 15. The first PUMRS study break will be on October 25 (RSVP on page 3), featuring graduate students affiliated with the Materials Science and Engineering program and the director of PRISM, Professor Richard Register.

I would like to thank everyone who contributed to the content of this issue. Good luck to everyone on their midterms and have a wonderful fall break!

— Zihan Lin 23'

Materials News

Method could reduce nondegradable plastics and greenhouse gas emissions

Sep. 29, 2022 | Texas AM AgriLife Communications | ScienceDaily

A team of researchers at Texas AM AgriLife has successfully developed a highly efficient integrated system that essentially uses carbon dioxide as a feedstock for bacteria to grow and produce bioplastics. This integrated system contributes to efforts in both reducing greenhouse gas emissions and plastic waste because the bioplastics synthesized by this system is biodegradable. The integrated processing system consists of two main units, with the first unit using electricity to convert carbon dioxide to ethanol and other two-carbon molecules and the second unit feeding ethanol produced to bacteria. Although leveraging on bacteria to produce bioplastics is not new, the system developed by the team is more efficient and opens the door to synthesizing cheaper bioplastics that has the potential to replace petroleum-based plastics.

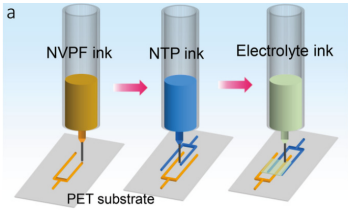
- H. Luu

Read More on Chem

3D Printing Flexible Sodium-Ion Microbatteries

Aug. 11, 2022 | Dalian National Laboratory for Clean Energy | Advanced Materials

Researchers from a collaboration of laboratories in China have developed a method for 3D printing micro-scale sodium-ion microbatteries (NIMBs). Conventional techniques to build these kinds of batteries, including lithography, have struggled to achieve batteries of significant capacities, but the team overcame these issues by constructing 3D-printable inks that can used as battery components; then, the 3D printing process allows for more precisely arranging the anode, cathode, and electrolyte, thus increasing the power capacity. These batteries have promising application to wearable electronics and micro-scale medical devices.



Derived from Wiley: 3D Printing Flexible Sodium-Ion Microbatteries

- C. Brown

Read More on Advanced Materials

Engineers discover process for synthetic material growth, enabling soft robots to grow like plants

Sep. 28, 2022 | University of Minnesota

Soft robots, made of more flexible and "soft" materials than a typical robot, create new material behind them as they grow. To allow soft robots to navigate more complicated environments, scientists and engineers at the University of Minnesota drew inspiration from the "tip growth" of plants and fungi, in which new material is synthesized at the growing end. The new soft robot uses light to turn liquid monomers into solid polymers, a process known as photopolymerization, and the extrusion of the solid polymers enables more effective growth and movement.

- J. Lin

Read More on Proceedings of the National Academy of Sciences

Scientists improve process for turning hard-to-recycle plastic waste into fuel

Sep. 29, 2022 | Penn State | ScienceDaily

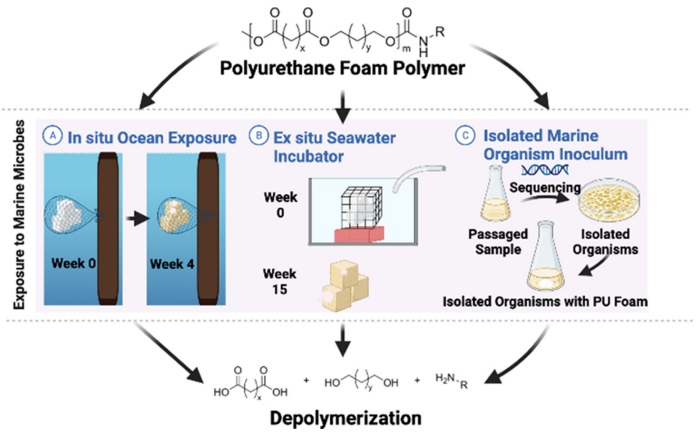
A team of researchers at Penn State has found a catalyst that could help to improve the process of mixed-plastic pyrolysis, which involves heating plastics up in an oxygen-free environment to produce liquid fuels. Currently, conversion using pyrolysis is limited to small-scale processes and certain plastics. This current limitations of pyrolysis technology does not allow for large-scale conversion of plastic waste, which is a complex mixture of different plastics. The finding of this catalyst is a step closer towards recycling and converting real plastic wastes to liquid fuels.

- H. Luu

Read More on Reaction Chemistry & Engineering

A Sea Change for Plastic Pollution: New Material Biodegrades in Ocean Water

Sep. 22, 2022 | University of California - San Diego



Derived from: Science of the Total Environment

Scientists at the University of California- San Diego have proven that their polyurethane foam, a more environment-friendly alternative to plastic given its ability to biodegrade on land, also biodegrades in the ocean. Marine microorganisms have been found to be capable of breaking down polyurethane foam into its monomers, which are then consumed by those same marine microorganisms. This work is part of the scientists' efforts to combat plastic pollution.

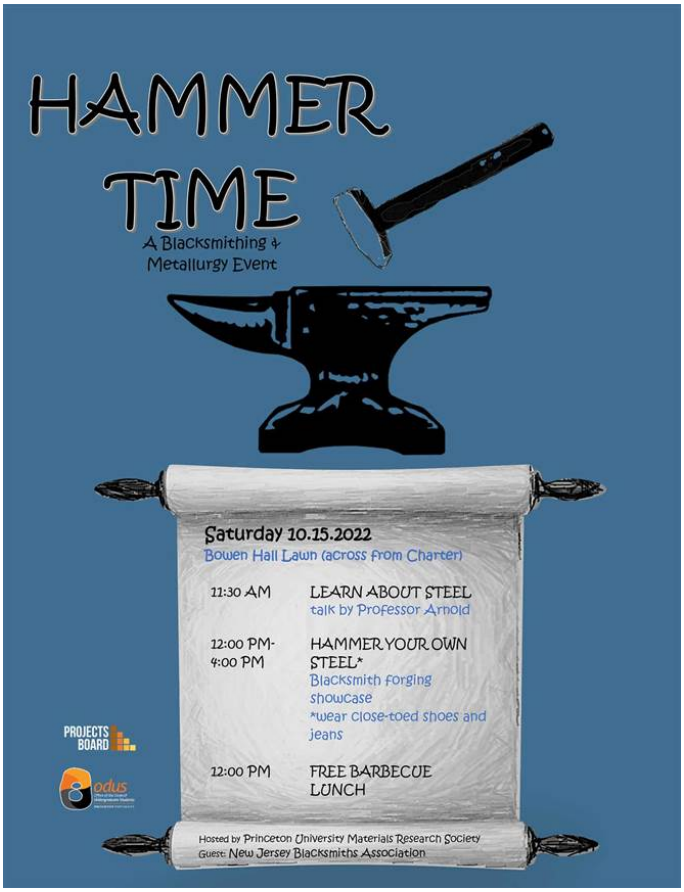
- J. Lin

Read More on Science of the Total Environment

PRISM Seminar

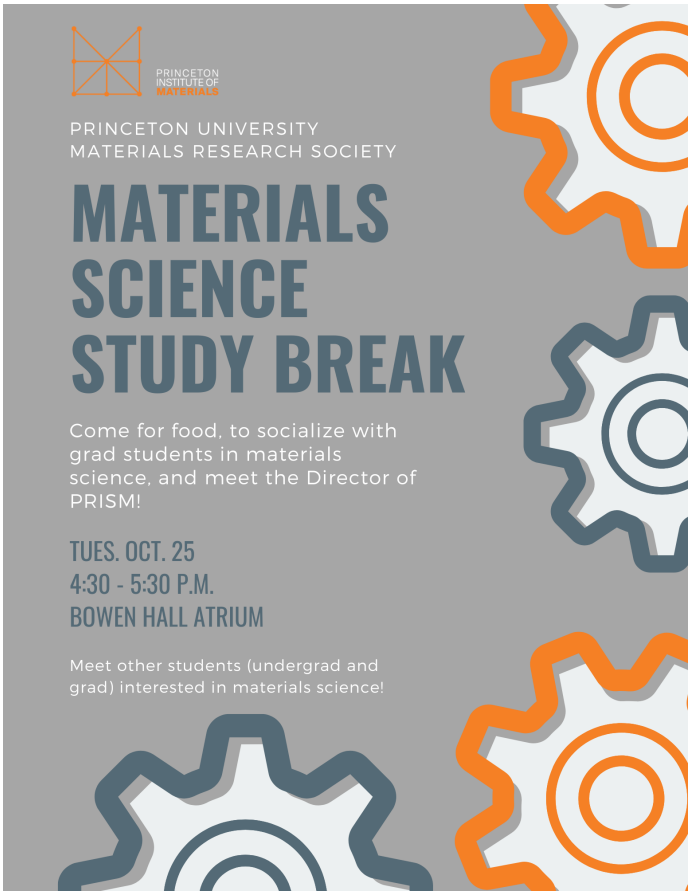
- Oct. 12, 2022, 12:00 pm—1:00 pm - "**Designing Random Heterogeneous Construction Materials for Fracture Resistance**"
- Oct. 26, 2022, 12:00 pm—1:00 pm - "**Integrated Photonic Interface of Van der Waals Materials and Low Power Optoelectronics**"

Blacksmith Event (Oct. 15)



By: Sandra Lam

PUMRS Study Break (Oct. 25)



By: Bhoomika Chowdhary