



# ANALYTICAL RESOURCES CORE

## COLORADO STATE UNIVERSITY

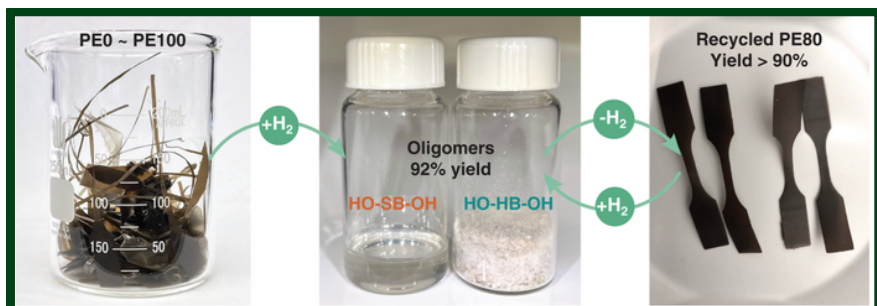
# ARC MONTHLY BULLETIN

## DECEMBER 2023

Welcome to the ARC Bulletin, a monthly newsletter to keep you informed about the latest happenings in the ARC. Here you will find information about our team, job opportunities, equipment and facilities, upcoming seminars, and other exciting news!

### RESEARCH SPOTLIGHT

This month's research spotlight features Dr. Yucheng Zhao's publication in Science "[Chemically recyclable polyolefin-like multiblock polymers](#)". Dr. Zhao is a Postdoctoral Fellow and a member of the Miyake research group within the Department of Chemistry at CSU. With the help of the ARC, Zhao has been able to research how to create recyclable polyolefin-like materials. Polyolefins are some of the most prominent and extensively manufactured plastics worldwide, and they present a notable challenge due to their substantial usage, their resilience to degradation in the environment, and the limited effectiveness of recycling methods.



Chemical recycling process of multiblock polymers

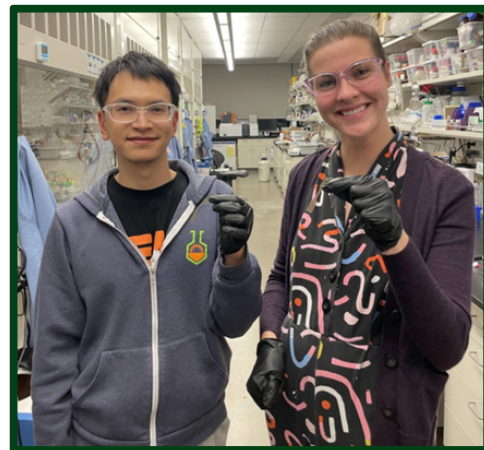


### ARC TRIVIA

Which area of technology available in the ARC has seen 5 different Nobel prizes throughout history?

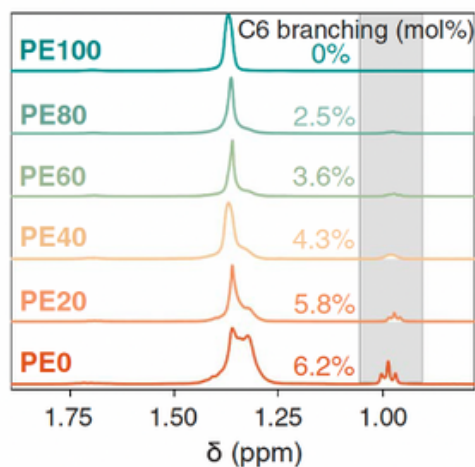
We look forward to featuring more of our users' research.  
Want to have your research in the spotlight?  
Be sure to cite our RRID (SCR\_021758) so that we can find you!

In response to this challenge, Zhao and the Miyake research group created a replacement polyolefin-like material that is chemically recyclable and offers a broad spectrum of favorable properties. **“These synthesized multiblock polymers display a wide array of mechanical characteristics, which can be tailored by adjusting the ratios of hard and soft building blocks,”** Zhao says. **“They possess a high melting temperature and a low glass transition temperature, making them versatile for applications ranging from elastomers to thermoplastics. Importantly, after their intended use, these multiblock polymers could be efficiently disassembled into their constituent hard and soft blocks for recycling purposes.”**

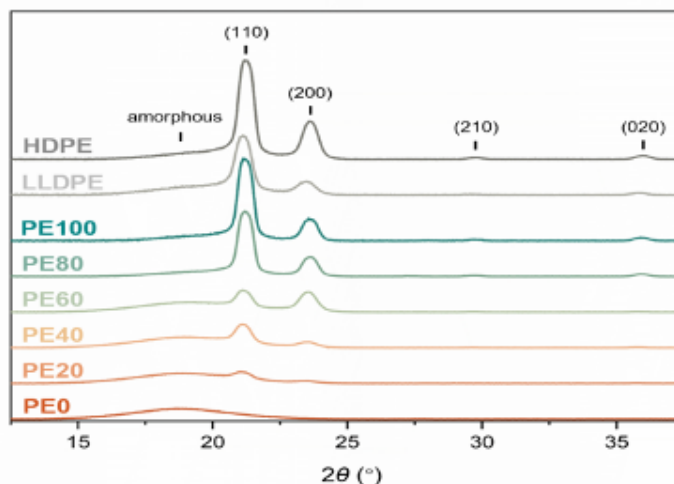


Yucheng Zhao (left) and right Emma Rettner (right, co-first author) with multiblock polymers

The ARC assisted in this research extensively, notably through training on various instruments and assistance during data collection and interpretation. Dr. Michele Mailhot assisted Zhao in using the Varian 500 MHz NMR spectrometer at high temperature (383 K) to characterize the conversions of polymerization and depolymerizations, which helped Zhao to optimize the reaction conditions and reveal important information about the structure of the multiblock polymers, e.g. the branching and ester content. Dr. Indrani Bhowmick helped with testing the samples by FTIR spectroscopy for chemical comparisons of the multiblock polymers compared to the commercial polyolefins. Former ARC X-ray specialist, Dr. Brian Newell helped with the use and reconfiguration of the Bruker D8 Discover DaVinci X-ray diffractometer for detecting wide-angle X-ray scattering to determine the type of polymer unit cell and make quantitative comparisons of crystallinity to polyolefins.



$^1\text{H}$  NMR spectra (@383K) of multiblock polymers revealing different branching content



Overlaid X-ray scattering patterns for multiblock polymers PE0-PE100 with different levels of soft and hard blocks, compared to commercial polyolefins, HDPE and LLDPE, revealing differences in crystallinity

**“We really appreciate the ARC’s services and guidance in solving issues so promptly,”** Zhao noted. **“After getting trained, we were able to use the instruments smoothly. By analyzing depolymerization and repolymerization products by NMR, we can easily verify that our recycling process is working.”**

Zhao plans to use X-ray diffraction, scanning electron microscopy, and high temperature size exclusion chromatography to aid in his future research that will involve analyzing the structure-properties relationship of multiblock polymers. With the continued assistance of the ARC, the Miyake research group anticipates obtaining more exciting and insightful data to propel their research.

Thank you Yucheng for speaking with us! We are thrilled to hear how our facilities have aided in advancing your high impact research.

## INSTRUMENT UPDATES

### Instruments faced with extended downtime

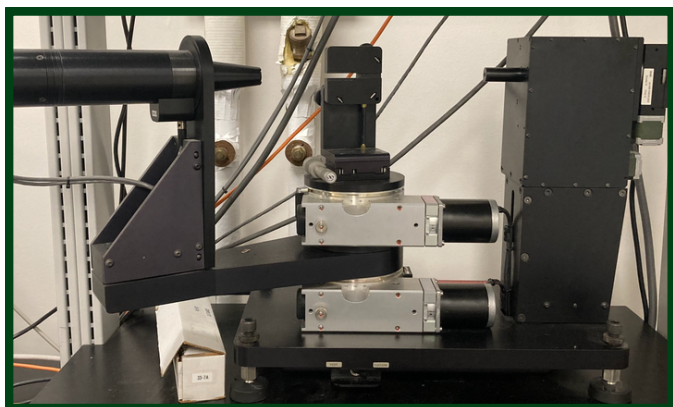
#### **Bruker D8 Advance QUEST Single Crystal XRD:**

The system experienced a failure of a component in the HV generator for the X-ray tube. Unfortunately, the generator will need to be repaired at Bruker. The ARC is making arrangements to ship the unit back to Bruker in the coming days. Expect the system to be down for several weeks. Indrani Bhowmick will follow up with users to discuss critical needs and alternative options in the region.

#### **500 MHz NMR:**

The AC and humidifier for the room that houses our 500 MHz NMR broke and is beyond repair. Without proper temperature control of that room, we cannot operate the 500 MHz NMR and would risk damaging the system. The ARC has ordered a new fan coil unit and a work order has been placed with Facilities. We anticipate 3-4 months until the new unit is installed. Michele Mailhot will follow up with users to discuss critical needs and alternative options on other ARC NMRs.

### Our Ellipsometer is available for walkup use again!



Our Variable Angle Spectroscopic Ellipsometer (VASE) is back to normal operation after a beam alignment followed by testing and verification. Ellipsometry measures the change in the polarization of light upon interaction with smooth, uniform, planar, multi-layer thin film samples. The measured data is fit to generated data from a sample model, so samples must be relatively known in composition and arrangement. Film thicknesses can be determined using published optical properties or vice versa.

This method is particularly valuable in physics, materials science, and chemistry, offering insights into the optical properties and thicknesses of thin films of a wide variety of materials such as semiconductor electronic devices and coatings.

Users can submit a Surface Analysis training request in iLab or simply reach out to [Rebecca.miller@colostate.edu](mailto:Rebecca.miller@colostate.edu) for more information.

## Did you know...

Did you know the ARC has an accurate mass gas chromatography coupled mass spectrometer? While most GC-MS systems use electron impact ionization and quadrupole mass spectrometers, the ARC-BIO Waters APGC-Q-TOF uses soft atmospheric pressure ionization and enables accurate mass (< 10 ppm mass error) MS and MS/MS capabilities. The atmospheric pressure source also offers some interesting ionization selectivity.

For more information, please contact  
**[Corey.Broeckling@colostate.edu](mailto:Corey.Broeckling@colostate.edu)**



## Sunsetting Bruker Microflex MALDI-TOF

We are looking for a good home for our Bruker MALDI Microflex LRF TOF mass spectrometer. The instrument was purchased new by the ARC in 2017, is fully functional and comes with FlexAnalysis and Compass MBT (for biotyper) software. The ARC no longer has a need for this instrument as we recently upgraded with a Bruker UltrafleXtreme MALDI TOF/TOF to address a need for higher resolution and MS/MS analysis by polymer and other macromolecular research groups at CSU.

If interested, please contact  
**[Corey.Broeckling@colostate.edu](mailto:Corey.Broeckling@colostate.edu)**



## TIMELINE FOR NEW SEM

While the ARC awaits the arrival of the new JEOL JSM-IT800(HL) ultra-high resolution variable pressure scanning electron microscope sometime late Spring 2024, JEOL is lending us a similar model SEM, the JSM-IT700HR, equipped with secondary (SE) and backscatter (BSE) electron imaging detectors as well as an energy dispersive X-ray spectroscopy (EDS) detector.

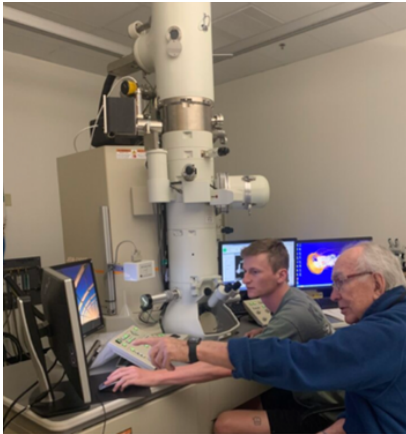
We anticipate the IT700HR installation will finish in early January 2024. The ARC will organize user training directly after installation.

For those interested in using the new scope, please [submit an Electron Microscopy training request](#) in iLab and select the SEM Loaner (JEOL IT700HR) option in the form. For more information on the JSM-IT700HR: <https://www.jeol.com/products/scientific/sem/JSM-IT700HR.php>



# LATEST EDUCATIONAL OFFERINGS

## Spring 2024 TEM Class



Our next TEM class will start the week of January 22. New this time is that the class will have two 4-week sessions, the first one focused on just imaging by TEM; the second session will be a follow up and more advanced analysis session for those interested in learning electron diffraction, STEM and EDS on the TEM. Both sessions will involve 2h/week of group lectures and 2h/week/person of private hands-on learning with Dr. Roy Geiss on the TEM. After completing the class and demonstrated proficiency, students will be able to run samples independently on the TEM. Expectations for participating in this class are having completed an hour of SEM training with Dr. Rebecca Miller, and an agreement from your PI for covering the class fee (\$900 per 4-week session). Each session will be capped at 5 students max.

Contact [Roy.Geiss@colostate.edu](mailto:Roy.Geiss@colostate.edu) for more information.

## ARC FIRST FRIDAY TOURS

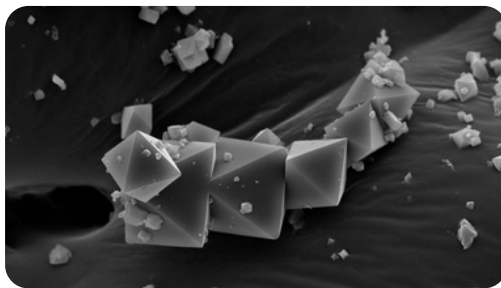
NEW!

The ARC will start hosting monthly tours of the facilities for all interested students, researchers and faculty starting in 2024.

- When: Every first Friday of the month 12-1:30pm.
- Register: <https://www.research.colostate.edu/arc/tour-demo-class-support-request/>
- Contact: [Karolien.Denef@colostate.edu](mailto:Karolien.Denef@colostate.edu).

Scan me to register!





# ARC FALL & SPRING SEMINAR SERIES

**Hosted by the Analytical Resources Core  
Office of the Vice President of Research**



**ANALYTICAL RESOURCES CORE**  
COLORADO STATE UNIVERSITY

Learn about the ARC's latest developments and newly added technologies available to CSU researchers and regional companies. This year the ARC experts themselves will present the technologies, analytical services, and educational resources each of their labs have to offer. Join us as we delve into a diverse array of scientific instruments and methodologies, enabling you to harness the full potential of our facilities.

Date	Presenter	Topic
September 6	Karolien Denef	Overview of the Analytical Resources Core
October 4	Corey Broeckling	Mass spectrometry-based metabolomics
November 1	Jackie Chaparro	Inductively coupled plasma mass spectrometry and ionomics applications
December 6	Roy Geiss	Electron microscopy
January 10	Linxing Yao	Targeted quantitative analysis
February 7	Gustavo Diaz	Metaproteomics - who is doing what in microbial communities
March 6	Claudia Boot	Self service mass spec offerings in the ARC
April 3	Indrani Bhowmick	Materials analysis techniques
May 1	Alyssa Winter May	MALDI mass spectrometry and macromolecular analysis
June 5	Rebecca Miller	Surface analysis techniques
July 3	Michele Mailhot	Nuclear Magnetic Resonance (NMR)
August 7	TBD	X-ray diffraction and scattering techniques

**First Wednesday of the month | 2-3 pm**

[www.research.colostate.edu/arc/arc-seminar-series/](http://www.research.colostate.edu/arc/arc-seminar-series/)

Join our [mailing list](#) to stay receive further updates

## ON THE CALENDAR



JAN  
5

### **First Friday ARC Tour 12-1:30pm.**

Meet in Chemistry C3 (Chemistry basement).  
Registration required.

JAN  
15

### **Targeted quantitative analysis using mass spectrometry. By Dr. Linxing Yao, ARC-BIO Mass Spectrometry Research Scientist.**

*Targeted metabolomics is to quantitatively analyze a pre-defined list of small molecules that are involved in metabolomic processes. This seminar will provide an overview of the assays that have been developed and adapted at ARC, the UPLC-triple quadrupole working principle, and tips for data processing.*

<https://www.research.colostate.edu/arc/arc-seminar-series/>

## TEAM UPDATES

ARC's Materials Analysis research scientist, Dr. Indrani Bhowmick, was selected as one of six participants to attend Quantum Design's New Winter School February 5-9, 2024 in San Diego. This week long winter school will provide advanced training on both the PPMS DynaCool and MPMS3 platforms. Indrani was invited to bring user samples to the winter school and will have a chance to discuss specific measurement options tailored to the needs and interests of our users. Some of ARC PPMS and MPMS3 users will be contacted by Indrani in the coming weeks about samples of interest.



## REMINDERS AND UPDATES

### PLEASE WEAR YOUR EYE PROTECTION!

Please remember to wear eye protection at all times when working in or visiting our laboratory spaces. Your safety is our utmost priority, and the reinforcement of wearing safety glasses is a proactive step to ensure the protection of your eyes and personal safety in accordance with CSU's safety regulations.

Safety glasses are available in the ARC. We kindly ask you to return these when leaving the laboratory.



### Try-ons and ordering available through Life Sciences Stockroom

Need a more comfortable, functional, or stylish pair of safety glasses? The ARC Life Sciences Stockroom (located in Microbiology C115) now carries 15 pairs of eyewear, including budget-friendly options, over-the-glasses styles, and Stoggles. These are available for try-ons to be ordered through the stockroom, M-F 9 a.m. to 4 p.m. For more information, please contact [dorathealee@colostate.edu](mailto:dorathealee@colostate.edu)

### ARC DURING WINTER BREAK

On CSU scheduled holidays during the Winter break, our self-use facilities will remain open to trained and experienced users, but staff support will be limited. ARC-BIO will be closed for business. The remainder of the break, the ARC will be operating with staff support unless otherwise communicated directly in instrument and lab Team chats in the ARC User Team.

**We wish all our users and colleagues a wonderful Winter break and Thank You for the opportunity to assist you in all your incredible research every day here in the ARC!**



## ARC TRIVIA ANSWER

### Mass spectrometry!!

- 1906: Thomson (Physics) "in recognition of the great merits of his theoretical and experimental investigations on the conduction of electricity by gases"
- 1922: Aston (Chemistry) "for his discovery, by means of his mass spectrograph, of isotopes, in a large number of non-radioactive elements, and for his enunciation of the whole-number rule."
- 1939: Lawrence (Physics) for the cyclotron
- 1989: Paul (Physics) "for the development of the ion trap technique"
- 2002: Fenn and Tanaka (Chemistry) "for the development of soft desorption ionization methods ... for mass spectrometric analyses of biological macromolecules."



# THANK YOU FOR CITING US USING OUR RRID!

Özkar S, MacHale LT, Finke RG. **Giant, Submicron Size, Yet Nearly Uniform IrO<sub>3</sub>, 30,000,000 Particles: Synthesis, "Raspberry" Structure, and Resultant Insights into Their Mechanism of Formation.** *The Journal of Physical Chemistry C*. 2023 Nov 21. [https://pubs.acs.org/doi/full/10.1021/acs.jpcc.3c04417?casa\\_token=13En3LISBzcAAAAA%3Auzhcz\\_9bIDlaaCPkgNuL\\_RE7CwYlapbr3PCHX4QNSEGXXwpvclXtnJ34O82Lu4XFGv8cp9YiW5cta7s](https://pubs.acs.org/doi/full/10.1021/acs.jpcc.3c04417?casa_token=13En3LISBzcAAAAA%3Auzhcz_9bIDlaaCPkgNuL_RE7CwYlapbr3PCHX4QNSEGXXwpvclXtnJ34O82Lu4XFGv8cp9YiW5cta7s)

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Torrelles JB, Chatterjee D. **Collected Thoughts on Mycobacterial Lipoarabinomannan, a Cell Envelope Lipoglycan.** *Pathogens*. 2023 Oct 26;12(11):1281. <https://www.mdpi.com/2076-0817/12/11/1281>

Martinez B, Leroux YR, Hapiot P, Henry CS. **Surface Modification of Thermoplastic Electrodes for Biosensing Applications via Copper-Catalyzed Click Chemistry.** *ACS Applied Materials & Interfaces*. 2023 Oct 24. [https://pubs.acs.org/doi/full/10.1021/acsami.3c10013?casa\\_token=UwrDijzT0RoAAAAA%3AUP2tx9-gzQ4zUKLkjHjp2xqrx8zyErj3KneYOppLNFjUNzWmPYWHqPeo800GpgaP\\_FPhyvADEvozsDk](https://pubs.acs.org/doi/full/10.1021/acsami.3c10013?casa_token=UwrDijzT0RoAAAAA%3AUP2tx9-gzQ4zUKLkjHjp2xqrx8zyErj3KneYOppLNFjUNzWmPYWHqPeo800GpgaP_FPhyvADEvozsDk)

Angala SK, Carreras-Gonzalez A, Huc-Claustre E, Anso I, Kaur D, Jones V, Palčeková Z, Belardinelli JM, de Sousa-d'Auria C, Shi L, Slama N. **Acylation of glycerolipids in mycobacteria.** *Nature Communications*. 2023 Oct 23;14(1):6694. <https://www.nature.com/articles/s41467-023-42478-x>

Thai JE, Roach MC, Reynolds MM. **Continuous flow catalysis with CuBTC improves reaction time for synthesis of xanthene derivatives.** *Frontiers in Chemistry*. 2023;11. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10613637/>



<https://www.linkedin.com/company/analytical-resources-core/>



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in publications that include any data generated in or by our facility