AIChE

Rocky Mountain AIChE News

May 2021 Volume 30 Number 8

May Section Meeting: Are Two Components Better than One? Investigation of Multi-component Materials for Catalysis and Environmental Remediation

Natural systems often use multiple sites or functionalities to perform complex tasks with remarkable rates and selectivities. Enzymes serve as excellent examples of utilizing multiple functionalities where their active sites are located in environments in which there are control of electrostatic interactions, precise placement of chemical functional groups, confinement of the active site, and control of hydrophobicity/hydrophilicity.

In this presentation, three different systems, each with two major components essential to the function, will be presented. The first system uses bimetallic gold alloy nanoparticles to demonstrate a synergy between the gold and the other metal such as to tune the properties and the catalytic performance of these materials in CO oxidation and methane oxidation. We observe distinct catalytic differences when we pair FCC Au with non-FCC metals. The second example demonstrates the synthesis, characterization, and catalytic performance of hybrid enzyme-bound nanoparticle systems. In this work, gold is paired with an oxidase enzyme to perform oxidation reactions in series using both the enzyme and

May Section Meeting

Topic: Are Two Components Better than One? Investigation of Multi-component Materials for Catalysis and Environmental Remediation

Speaker: Dr. Michael Nigra, Assistant Professor of Chemical Engineering, University of Utah

Date: Tuesday, May 18th

Time: 6:00 – Career Discussion
6:15 – Presentation and Q & A

Cost: Free, Registration Required

Location: Online Zoom meeting

REGISTRATION REQUIRED. More information can be found on our website.

Register

After your request has been approved, you'll receive instructions via email for joining the meeting.

the gold nanoparticles as active catalysts, analogous to substrate channeling in biological systems. The third system will demonstrate the use of a hybrid organoclay-gold nanoparticle material that will be applied to the removal of methyl mercury from aqueous systems.

Dr. Michael Nigra is an Assistant Professor of Chemical Engineering at the University of Utah. He received his bachelor's degrees in Chemical Engineering and Biomedical Engineering from Carnegie Mellon University in Pittsburgh in 2007. He then obtained his Ph.D. from University of California, Berkeley in 2013 under the direction of Professor Alex Katz. From 2014-2016, he was a senior research associate in the Department of Chemical Engineering and the Centre for Nature Inspired Engineering at University College London. At the University of Utah, he leads a multidisciplinary research group that designs important nanoscale interfaces for applications in catalysis, carbon management, environmental engineering, and medicine. Dr. Nigra's important teaching contributions have been recognized by his department and college. In 2020, he was the recipient of the College of Engineering's Outstanding Teacher Award, the highest teaching award in the College of Engineering.

THANK YOU LETTER

April 13, 2021

Colorado Science and Engineering Fair

Michael Mutnan
American Institute of Chemical Engineers, Rocky Mountain Section
7248 DeFrame Court
Arvada, CO 80005

Dear Mr. Mutnan

The Colorado State Science Fair Board of Directors joins me in thanking you and/or your organization for the generous support you have provided for the 2021 Colorado Science and Engineering Fair (CSEF). Your total special award contribution of $350 was received and is a wonderful and tangible way to encourage Colorado's top young scientists. The special award program is as important to the organization as the grand awards that we provide.

By making this contribution through the CSEF as a nonprofit organization rather than directly to the student, it is tax deductible. Our tax identifying number is 74-1884595.

As part of our recognition package for being a Special Award Organization, your organization/company will be afforded the following benefits.

Your company/organizational name will be listed in the CSEF Program and CSEF Award Ceremony Program as a Special Award Organization.

Your company/organizational name will be listed in the CSEF Press Release along with the winners and the awards presented.

Thank you again for your generous support. America needs more scientists, engineers and mathematicians and we need you to help encourage Colorado's young people in these fields. We appreciate your involvement.

Sincerely,

Courtney Butler
CSEF Director

Lucy Adams
CSSF, Inc. President

SCIENCE FAIR WINNERS

The section judges: Rebecca Spearott, Doug Brown and Michael Mutnan have completed the virtual judging. The winners are below:

Junior Division 1st Place

Project Title: Identification and Characterization of the Natural Sweetener: Brazzein
Student: Angelina Wang
School: Summit Middle Charter School (Boulder)

Abstract: It is well known that overconsumption of sugar can lead to obesity and diabetes. American obesity rates reached 42.4% in 2017 and 34.2 million Americans had diabetes and 88 million American adults had pre-diabetes in the year 2020. Sweeteners are good sugar substitutes, however, many of the current sweeteners have drawbacks, for example honey is caloric and other zero-calorie sweeteners have bitter or metallic aftertastes. In this study, a new sweetener candidate called Brazzein was introduced and its thermal stability was tested. Brazzein is a natural protein that has a sugar-like taste with zero calories. A series of tests were conducted in order to determine Brazzein's thermal stability over a broad range of temperatures and incubation times. This study shows that Brazzein's stability decreases as both temperature and incubation time increase. Brazzein was able to maintain 100% stability at room temperature for 48 h and 80% stability at 70℃ for 5 h; and its stability significantly drops when the temperature is above 80℃. It was only able to maintain 80% stability at 90℃ for 30 minutes and 100℃ for 10 minutes. These results suggest that Brazzein is suitable for ice cream, desserts, and cold and hot beverages, but not for baking or boiling

Junior Division 2nd Place

Project Title: Wildfire Debris Mitigation and Feasibility for Use in Emergency Water Filtration Systems
Student: Presley Wilson and William Wilson
School: Sangre de Cristo Undivided High School (Mosca)

Abstract: The purpose of this project was to determine the feasibility of using charcoal debris from wildfires in an emergency water filtration kit. FEMA and the EPA encourage reusing and recycling debris from natural disasters. The Spring Creek wildfire (2018) burned 108,045 acres of mostly forest land. At a low estimate of 40 trees per acre, approximately 4.3M trees were burned. Methods: 1. gather charcoal for processing, 2. activate charcoal, 3. design and make water filters, 4. test the water for quality, 5. design a prototype emergency water filtration kit. Four types of filters were used: (1) commercial PUR filter, (2) homemade charcoal, (3) salvaged charcoal, and (4) harvested charcoal. The controls were distilled water and tap water without filters. Filter (1) was tested with tap water. Filters (2), (3), and (4) were tested (activated and unactivated) with both distilled water and tap water to determine if the charcoal filters improved water quality or added contaminants. Activated homemade and harvested charcoal both improved the quality of tap water. Further testing, using the CDC recommended disinfectant for emergency situations, showed that treating distilled water with a drop of bleach increased several testing levels; while the same water run through the activated harvested charcoal filter returned the levels back to those of the distilled control confirming that harvested charcoal from wildfires does have the potential to mitigate wildfire debris and decrease risk to human victims of hurricanes from contaminated drinking water. A prototype emergency water filtration kit was designed.

Senior Division 1st Place

Project Title: Separating Microplastics from Beach Sand Using a Fluidized Air Bed
Student: Sean Brooks

School: Pine Creek High School (Colorado Springs)

Abstract: Microplastics pose an increasing risk to beach ecosystems around the world. The abundance of microplastics negatively impacts natural processes such as evaporation, water flow, and heat transmission to lower levels of sand, endangering numerous organisms that depend on beaches for their survival. Current systems designed to clean microplastics from beach sand are expensive and have low plastic separation efficiencies.

Fluidized air beds, which force air upward through particulate media resting on a porous membrane to separate particles by density, present possibilities for significant cost savings and improved separation efficiencies. This experiment investigates the use of a fluidized air bed to separate microplastics from beach sand. A fluidized bed prototype was constructed using a leaf blower to force air through a piece of fabric, causing microplastics to rise to the top for harvesting and weighing. In testing sand mixtures with two common types of plastic, polypropylene (PP) and polyethylene terephthalate (PET), average separation efficiencies of 83% for PP and 43% for PET were achieved. These results compare favorably with the most common laboratory method for PP and show potential for PET with bed modifications. Fluidization time for this experiment was only 30 seconds, indicating that the fluidized bed prototype can achieve high separation efficiencies in a short amount of time. In addition, materials cost less than $350, suggesting the potential for significant cost savings. Applications of this research include cleaning polluted beaches and laboratory analysis of sediment samples.

[This project had high grades and drew praise for being a “pure” chemical engineering focused effort and was a noteworthy example of Unit Operations well known to chemical engineers]

Senior Division 2nd Place

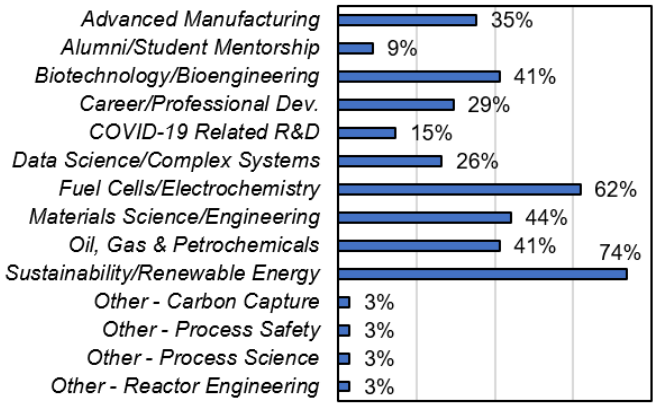
Project Title: Implementation of a Copper Catalyst for Methane Hydrate Formation
Student: Arjun Batra
School: Cherry Creek High School (Greenwood Village)

Abstract: My computational chemistry project uses molecular simulations to determine if a copper surface can catalyze the formation of methane clathrate hydrates. Clathrate hydrates are formed when water cages trap gas molecules. These compounds can be used to sequester greenhouse gases and store energy, where coming up with a feasible catalyst is important in order to make the storage and sequestration processes scalable on an industrial level. The rationale behind using the copper surface (specifically Cu (110)) as a catalyst is that when water vapor freezes over the copper surface in experiment, the lowest energy state involves pentagonal water faces; this geometry is also exhibited in the structure of hydrates. Through my investigation, my hydrate simulations validated that the computational parameters I used were appropriate to represent hydrate accurately. In my simulations involving copper and water, I computationally replicated the experimental values of interface tension, ensuring that the copper was also correctly implemented in simulation. Performing further investigations of copper and bulk water, my results indicated that in simulation, water formed hexagonal faces instead of pentagonal shapes, suggesting that bulk liquid water may influence the shape of the water faces. With the hexagonal geometry, copper could still be a catalyst for methane hydrate formation, considering that hexagonal faces are also present in the structure of hydrates. My research warrants further investigation into the water and copper interface, where I eventually look forward to implementing copper with methane and water to determine if this metal surface catalyzes the formation of methane hydrates.

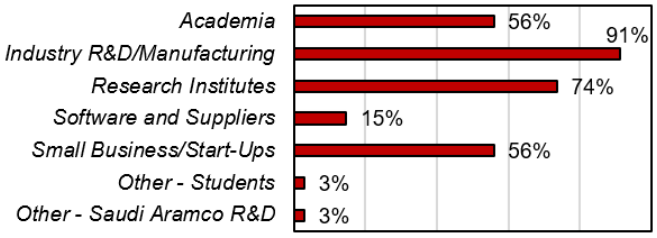
Survey Spotlight: 2021–2022 AIChE RMLS Programming Summary

In March 2021, the AIChE RMLS leadership released a programming survey to better serve the needs of our regional members for the 2021–2022 season. Highlights of the 34 member responses received are summarized below. The survey will remain open through May 2021 if you would like to contribute your own preferences and recommendations (see survey link). If you would like to join the AIChE Rocky Mountain Local Section to further have your voice hear, please see the registration link. Annual dues are $20 are help support chapter programming and catering efforts for future in-person events.

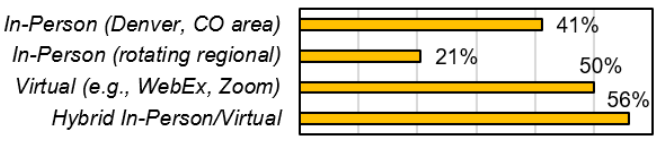
Presentation Topic Areas of Interest



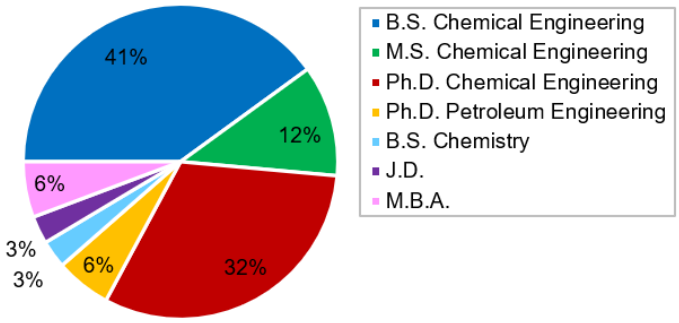
Speaker Recruitment Preference



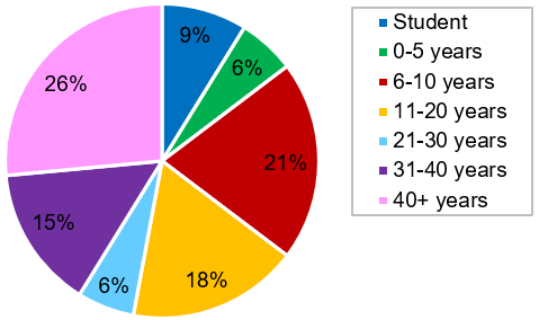
Venue Preference



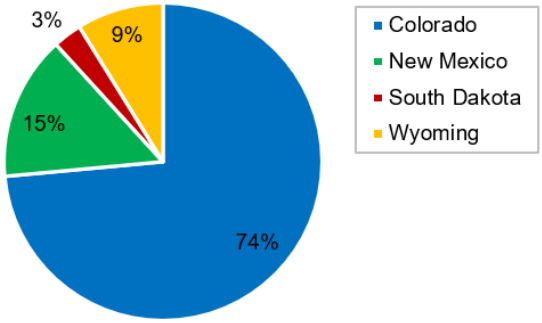
Highest Degree Held



Years of Experience

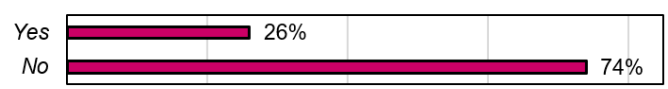


State of Residence



In the spirit of surveys, we also sought to include a recent poll question published in the April 20, 2021 electronic edition of the AIChE SmartBrief newsletter. The question is as follows: *"Did you take any time off from your career specifically due to the COVID-19 pandemic (either voluntarily or not voluntarily)?"* Please see the results of national member responses below.

AIChE SmartBrief Poll Results



AIChE Meetings

2021

May 16-19	Int'l Conference on Accelerated Carbonation for Environmental and Material Engineering (ACEME 2021) Virtual
May 18-20	2nd PD2M Future of Pharmaceutical Manufacturing Conference Virtual
June 15- 18	2021 Synthetic Biology: Engineering, Evolution & Design (SEED) Virtual
Nov 7-19	2021 AIChE Annual Meeting Boston Nov 7-11 Virtual Nov 15-19

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Rocky Mountain AIChE News is published nine times a year by the Rocky Mountain Local Section (RMLS) of AIChE. Opinions expressed herein are those of the authors and are not necessarily those of AIChE nor the officers of this section.

The objectives of AIChE are to advance chemical engineering in theory and practice, to maintain a high professional standard among its members, and to serve society, particularly where chemical, engineering can contribute to the public interest.
AIChE Rocky Mountain is a public non-profit 501(c)(3) organizations and thus all donations are tax deductible.

MEETING SCHEDULE

The Rocky Mountain Local Section (RMLS) of AIChE generally meets the second or third Tuesday of every month, September through May.

CALL FOR PRESENTERS

Do you have a presentation to share with our AIChE group? We are looking for presenters for our 2021-22 program year. Contact Nick Thornburg at nicholasthornburg2017@u.northwestern.edu