OCTOBER 2024





OUR GROUP IN 2024:

BACK ROW: WYATT BENSON, HOPE FELTENBERGER, VINCENT MICUS, COLE RITCHIE, NICHOLAS JARAMILLO, DR. IGOR ALTMAN (NAWCWD), DR. ADELIA AQUINO, LUKE CROESSMANN, DR. ANDREW DEMKO (NAWCWD), CONNOR KEY, JOSEPH MICUS, DR. KEVIN HILL (NAWCWD), JERIMIAH ZAMORA, LARRY QUEEN. FRONT ROW: ISHRAT MALEK, KALLIST KUNZLER, DR. MICHELLE PANTOYA



TEXAS TECH

UNIVERSITY.

ISSUE HIGHLIGHTS

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DEAR FRIENDS,

The combustion lab celebrated our 23rd anniversary of its founding at Texas Tech in August 2024. This newsletter highlights some of our most impactful projects in 2023-2024 and our recent graduates. Our group is thankful to you: our sponsors and our collaborators that help make our progress possible. Thank you for your continuing support.

Warmest Wishes,

MICHELLE PANTOYA

J. W. Wright Regents Endowed Chair Professor & Director, Combustion Lab Mechanical Engineering Department



STUDENT CENTRIC MEANS STUDENTS OWN THEIR WORK. THEY PRESENT IT AT CONFERENCES AND TO OUR VISITORS. THEY BECOME EXPERTS. TEXAS TECH STUDENTS TAKE PRIDE IN THEIR CONTRIBUTIONS AND STRIVE TO PUSH THE FRONTIERS OF KNOWLEDGE.



UPDATES

In 2023–2024, we are thankful to the Department of Energy (DOE) and Department of Navy (DON) for STEM grants that focus on developing the next generation of energetic material experts for national security and defense technologies.

We are also thankful to the Army Research Office for the Energetic Materials Basic Research (EMBR) Center. This multi-university center head out of Purdue provides Texas Tech students with many opportunities study with Army scientists and focus on national defense needs.

The STEM grants combined with our fundamental research grants help us increase our capacity to serve students that will make a positive difference in our world.



PROJECT HIGHLIGHTS

(1) CONTROLLING BURN RATES WITH SURFACE ENERGY

Annealing and quenching Al particles reduces surface energy and influences reactivity. The reduced surface energy pushes individual particle reactivity into faster burning regimes than previously thought possible. In 2024, we showed that diffusion-controlled combustion is possible for small particles, and the burning process is not limited by kinetics.



(2) SURFACE REACTIONS ON METAL PARTICLES

The Holy Grail for metal particle combustion is to harness chemical energy stored within metal fuel particles at time scales relevant to a detonation. We are transforming the inert alumina passivation shell surrounding the aluminum core into an oxidizer rich molecular structure called a metal inorganic framework (MIF). The MIF coated Al particles offer supplemental oxygen in the reaction wave and promote detonation.



(3) NEW DATA ANALYTICS FOR DETECTING PATTERNS IN METAL OXIDATION

There is far more below the surface of emission data than simply temperature. We are introducing new ways of analyzing pyrometry data. The data analytics are akin to the time series analyses performed daily to forecast the weather or predict the stock market. The idea is to identify patterns that can be linked with observations to understand processes that are otherwise overlooked. We are working with our Navy partners and at the cusp of transforming energetic material science.



WHERE ARE THEY NOW?

PHD GRADUATES

Michael Bello (May 20) – Post Doc, TTU

Billy Clark (August 16) – Director of R&D, BiSn, Houston, TX

Eric Collins (August 13) – Mechanical Engineer, Hill Air Force Base, Salt Lake City, UT

Charles Crane (May 13) – Research Scientist, Los Alamos National Laboratory, Los Alamos, NM

Birce Dikici (May 09) – Professor, Embry-Riddle Aeronautical University, Daytona Beach, FL

Cory Farley (May 13) – Research Scientist, Los Alamos National Laboratory, Los Alamos, NM

John Granier (May 05) – R&D Director, Element Defense Systems, Austin, TX

Kevin Hill (May 19) – Research Scientist, Naval Air Weapons Station, China Lake, CA

Emily Hunt (May 05) – Dean, Engineering, West Texas A&M University, Canyon, TX Shancita Islam (May 21) – Research Scientist, Eurofins Scientific, CT

Matt Jackson (May 07) – Dean, Engineering, Hardon Simons University, Abilene, TX

Keerti Kappagantula (August 14) – Research Scientist, Pacific Northwest National Laboratory, WA

Jena McCollum (August 15) – Assistant Professor, University of Colorado, Colorado Springs

Kelsey Meeks (December 16) – Research Scientist, Sandia National Laboratory, Albuquerque, NM

Kelsea Miller (May 22) – Research Scientist, Edwards Air Force Base, OH.

Oliver Mulamba (December 13) Director of Technology, AquaSmart Enterprises, Lubbock, TX

Richa Padhye (August 17) – Materials Scientist, Intel R&D, OR



Armando de Rezende (May 24) Research Scientist, Los Alamos National Laboratory, Carlsbad, NM

Dylan Smith (August 17) – Weapons Engineer, Eglin Air Force Base, FL

Shawn Stacy (August 13) – Research Scientist, Sandia National Laboratory, Albuquerque, NM

Quan Tran (December 22) -Research Engineer, Pantex, Amarillo, TX

Alan Williams (December 22) – Research Scientist, Sandia National Laboratory, Albuquerque, NM

Connor Woodruff (May 21) – Post Doc, Naval Surface Warfare Center, Indian Head Division, MD



MASTERS GRADUATES

Kavya Balupari (Aug 09) – Project Engineer, Bechtel, Houston, TX

Bryan Bockmon (May 03) – Co-Founder, RMSL, CO

Jonathan Burkhard (Dec 07) – Utility Engineering, Amarillo, TX

K. Ryan Bratton (May 19) – Idaho National Lab, Idaho Falls, ID

Steven Dean (Dec 08) – Research Engineer, Sandia National Lab, NM

Andrew Francis (Dec 07) -Xcel Energy, Amarillo, TX

Jeffrey Gesner (May 12) – Combustion Performance Engineer, Cummins, Columbus, IN

Sanjana Datta Greenhill (May 09) – Michael Baker Jr. Consulting, Alaska Amanda Gordon (May 11) – Fixed Equipment Engineer, ExxonMobil AAEO, Baytown, TX

Clayton Miller (May 23) – Lockheed Martin, Engineer, Dallas, TX

Kevin Moore (May 05) – Raytheon Company, Mckinney, TX

Eric Nixon (Aug 09) – Mechanical Engineer, Cummins Natural Gas Engines, Clovis, NM

Dustin Osborne (May 06) – Research Engineer, Southwest Research Institute, San Antonio, TX

Nicholas Podney (May 21) – Engineer, Firehawk, Dallas, TX

Kade Poper (August 14) – Research Engineer, Sandia National Lab, NM

Daniel Prentice (May 06) – Research Scientist, Idaho National Laboratory, Idaho Falls, ID Kenneth Shifflet (May 03) – Severn Trent De Nora, Sugar Land, TX

Donya Thomas (May 16) – Zimmer Biomet, Warsaw, IN

Ethan Vargas (May 18) – Mechanical Engineer, Lubbock, TX

Renita Walzel (May 19) – Los Alamos National Laboratory, Los Alamos, NM

Kyle Watson (May 07) – Pantex, Amarillo, TX

Chelsea Weir (May 12) – Specialty Engineer (R&D), Lyondell Basell, Houston, TX

Alan Williams (May 20) – Northrup Grumman, Los Angeles, CA

Randy White (May 06) – Raytheon Advanced Products Center, Dallas, TX

Ethan Zepper (August 16) – Sandia National Laboratory, Albuquerque, NM





JOE PANTOYA AND WYATT BENSON SYNTHESIZING A NEW OXIDIZER, APRIL 2024



THE SCIENCE SPECTRUM GALA - OUTREACH FOR STEM EDUCATION IN OUR COMMUNITY



PACKING IT UP! FRANK MUNIZ, REBECCA STOKES, JOE MICUS, KALLIST KUNZLER, CLAYTON MILLER, AND ALEX MULLER SHOW OFF OUR NEW BACKPACKS



TEAM SPORTS: TEXAS TECH INTERMURAL SOFTBALL

OUR ACCOMPLISHMENTS WOULD NOT BE POSSIBLE WITHOUT THE ENCOURAGEMENT AND SUPPORT FROM VERY SPECIAL PEOPLE. THANK YOU:

Dr. Ralph Anthenien, Army Research Office Dr. Tim Ransom, Office of Naval Research Dr. Betsy Snell, Department of Energy Dr. Michael Simpson, Office of Naval Research Dr. Anne Marie Petrock, US Army Picatinny Arsenal Dr. Joseph Abraham, Karagozian & Case Dr. John Granier, Element Defense Systems Dr. Pascal Dube, Matsys Inc. J.W. Wright Endowment, The Wright Family & Texas Tech University

OUR CONTRIBUTIONS TO THE ARCHIVAL LITERATURE (2023-2024)

Jones, H., Dube, P., Tran, Q., Pantoya, M., Altman, I., Demonstrating the significance of radiant energy exchange during metal dust combustion, Case Studies in Thermal Engineering 48, 102809, 2023.

Tran, Q., Vaz, N., Pantoya, M.L., Altman, I., Effectiveness of Metal Particle Combustion Performance and Implications to Martian Missions, Fuel 342, 127805, 2023.

Rizzo, G.L., Biswas, S., Antonov, I., Miller, K.K., Pantoya, M.L., Kaiser, R.I., Exotic Inverse Kinetic Isotopic Effect in the Thermal Decomposition of Levitated Aluminum Iodate Hexahydrate Energetic Particles, Journal of Physical Chemistry Letters 14, 2722-2730, 2023

Shancita, I., Altman, I., Burnett, D., Zorrilla, E.G., Garcia, A.R., Hill, K.J., Pantoya, M.L., Demonstrating an Altered Metal Oxidation Reaction Mechanism Correlated with Variations in Surface Energy, Thermochemica Acta, 725, 179521, 2023.

Williams, A., Short, M., Fah, T., Gupta, S., Pantoya, M.L., Advancing the Mechanical Integrity and Fragmentation Behavior of Reactive Projectiles, Journal of Applied Physics 133, 235901, 2023.

Gottfried, J.L., Miller, K.K., Giri, L., Pantoya, M.L., Laser-Induced Plasma Physiochemistry of Propellant Oxidizers, JANNAF Journal of Propulsion and Energetics 13(1), 2023.

Vaz, N.G., Pantoya, J.D., Miller, K.K., de Rezende, A., Aquino, A.J.A., Demko, A.R., Pantoya, M.L., A Metal Inorganic Framework (MIF) Designed as a Propellant Burn Rate Modifier, Advanced Engineering Materials 25(21), 2301099, 2023.

Jaramillo, N., Ritchie, C., Pantoya, M.L., Altman, I., Establishing Calibration Free Pyrometry in Reactive Systems and Demonstrating its Advanced Capabilities, Applications in Energy and Combustion Science 16, 100230, 2023.

Rezende, A., Pantoya, M.L., Tunega, D., Aquino, A.J.A., Prediction of phase transition and ignition sensitivity of ammonium periodate, Journal of Physical Chemistry C 128(5), 2205-2214, 2024.

Altman, I., Pantoya, M.L., Energy Balance and Global Characteristics of Metal Dust Flames, Combust Flame 261, 113310, 2024.

Biswas, S., Paul, D., Dias, N., Kunzler, K., Ahmed, M., Pantoya, M., Kaiser, R., Stress-Alteration Enhancement of the Reactivity of Aluminum Nanoparticles in the Catalytic Decomposition of Tetrahydro Dicyclopentadiene (JP-10), Journal of Physical Chemistry A: Molecules, Clusters, and Aerosols 128(18), 2024

Malek, M.I., Benson, W., Pantoya, J.D., Collard, D., Son, S., Pantoya, M.L., Synthesis of Bayerite Passivated Aluminum Particles and their Combustion in Solid Propellants, ACS Applied Engineering Materials, 2(6), 1603–1611, 2024.

Cagle, C., Pantoya, M.L., Fireball dimensionality and its influence on thermography data interpretation, Measurement 235, 115020, 2024.

Micus, J.L., Wu, C.-C., Walck, S.D., Thapa, D., Pantoya, M.L., Hydration-Induced Plasma Surface Modification of Aluminum Nanoparticles for Power Generation in Oxygen Deficient Environments, Surface & Coatings Technology 488, 131054, 2024.

Zamora, J., Rezende, A., Neeman, R., Vaz, N., Demko, A., Pantoya, M.L., Tunega, D., Aquino, A.J.A., Modeling adsorption reactions of ammonium perchlorate on rutile and anatase surfaces, Journal of Computational Chemistry, 1–10, 2024.

Jaramillo, N.R., Ritchie, C.A., Pantoya, M.L., Altman, I., Signature of Nano Alumina Condensation during Metal Combustion, International Journal of Heat and Mass Transfer 233, 126039, 2024.

Rizzo, G.L., Biswas, S., Pantoya, M.L., Kaiser, R.I., Unraveling the ignition chemistry of singly levitated aluminum iodate hexahydrate (AIH) particles, Chemical Physics Letters 842, 141212, 2024.

ACTIVE GRANTS, CONTRACTS & AWARDS

1.Growing STEMS Consortium: Training the Next Generation of Engineers for the DOE NNSA Workforce; PI: Michelle L. Pantoya (Texas Tech University); Source: US DOE/NNSA; Program Manager: Dr. Betsy Snell; Award No. DE NA0003988; 04/15/2021-04/15/2025; Award: \$3,000,000.

2.Growing STEMS Partnership: Training the Next Generation of Engineers for the Naval Enterprise; PI: Michelle L. Pantoya; Source: Office of Naval Research; Program Manager: Dr. Michael Simpson; Award No. N00014-21-1-2519; 06/23/2021-06/23/2025; Award: \$750,000.

3.Energetic Material Training for the Next Generation Naval Workforce; PI: Michelle L. Pantoya; Source: Office of Naval Research; Program Manager: Dr. Trevor Headman; Award No. N00178-24-1-0009; 08/01/2024 - 09/30/2027; Award: \$300,000.

4.Synthesis and Characterization of Metal Fuels for Enhanced Reactivity; PI: Michelle L. Pantoya; Source: Office of Naval Research; Program Manager: Dr. Chad Stoltz; Award No. N00014-22-1-2006; 11/01/2021-10/31/2025 (4 years), Award: \$600,000.

5.Novel Metal Surface Chemistry for Fast Reacting Fuel Particles; PI: Michelle Pantoya. Source: Army Research Office; Program Manager, Dr. Ralph Anthenien; Award No. W911NF-22-2-0168; 09/30/2022-09/29/2025; Award \$525,000.

6.Energetic Material Basic Research (EMBR) Center; Co-PI: Michelle Pantoya. Source: Army Research Office; Program Manager, Dr. Ralph Anthenien; Award No. W911NF-22-2-0170; 09/30/2022-09/29/2025; Texas Tech Total Award: \$579,655.

7. Analyzing Equilibrium Kinetics of Surface Reactions in Energetic Materials; PI: Michelle Pantoya. Source: Army Research Office; 09/01/2023-08/31/2024; Award: \$105,072.

8.Advancing experimental diagnostics for obscurant testing; PI: Michelle Pantoya. Source: Department of Defense (DEVCOM CCDC AC, Picatinny Arsenal vis Excet Incorporated); DEVCOM Program Manager: Dr. Danielle Kuhn; 08/17/2023-02/28/2025; Award: \$83,236.50.

9.Material Property-Functional-Performance characterization studies for solid fuel combustion PI: Michelle Pantoya. Source: Department of Energy, Consolidated Nuclear Security, LLC; Program Manager: Mr. Caleb Heltenberg; Award: \$100,000; 08/21/2-23-08/20/2024.

10.Advancing engineering practices toward nuclear security purposes; PI: Michelle Pantoya. Source: Department of Energy, Consolidated Nuclear Security, LLC; Program Manager: Mr. Caleb Heltenberg; Project Location: Texas Tech University; Total Award: \$225,000; Duration: 08/21/2-23-08/20/2025.

11.Pycnometer Testing and Redesign Support; PI: Michelle Pantoya; Source: Department of Energy, Consolidated Nuclear Security, LLC; Program Manager: Ms. Ashley Rojas; 10/1/2022-09/30/2024; Award: \$84,129.

12.Consumable Fragment Research and Development; PI: Michelle Pantoya. Source: MSI Stem Research and Development Consortium (MSRDC); Program Manager: Dr. Anne-Marie Petrock (DEVCOM CCDC AC, Picatinny Arsenal); Award No. W911SR22F0047; Award: \$356,208; 10/09/2023 - 10/08/2025.

13.Reactive Boron Fuel for Energetic Applications; Co-PI: Michelle Pantoya (PI: Dr. Adelia Aquino). Source: TDA Research, Inc.; Program Manager: Dr. Brady Clapsaddle; Project Location: Texas Tech University; 12/16/2022-09/27/2024; Award: \$65,500.



CONTACT US

www.depts.ttu.edu/me/combustionlab/ (806) 834-3733 Mechanical Engineering North 201G Texas Tech University Lubbock, TX 79409-1012

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