

PRANJAL NAUTIYAL

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RESEARCH INTERESTS

- Nanomechanics and Nanotribology: *In-situ approaches to study mechanisms of deformation, wear and friction*
- Mechanochemistry: *Study of stress-assisted chemical reactions at sliding contacts*
- Nanocomposites: *Processing and mechanics of composites based on 1D and 2D nanomaterials*

RESEARCH PRODUCTIVITY

Peer-reviewed Journal Articles: 38 | Patents: 5 | Book: 1 | Citation metrics: [Google Scholar](#)

EDUCATION & TRAINING

- **Postdoctoral Researcher** in Carpick Nanotribology Group (2020 – Present)
Mechanical Engineering and Applied Mechanics, University of Pennsylvania, Philadelphia, USA.
PI: Prof. Robert W. Carpick; Research focus: Nanotribology, Mechanochemistry, Lubrication
Webpage: <https://carpick.seas.upenn.edu/pranjal-nautiyal/>
- **Doctorate in Materials Science & Engineering** (2020)
Florida International University, Miami, USA.
Dissertation: Boron Nitride Nanotube based Lightweight Metal Matrix Composites: Microstructure Engineering and Stress-Transfer Mechanics
Advisors: Prof. Arvind Agarwal, Prof. Benjamin Boesl
- **Bachelor of Technology in Mechanical Engineering** (2015)
Indian Institute of Information Technology, Design & Manufacturing Jabalpur, India.

AWARDS, FELLOWSHIPS & OTHER ACHIEVEMENTS

1. **Nanomaterials and Energy Prize 2020, Institute of Civil Engineers** (London, United Kingdom, October 2020):
Awarded for the research paper entitled “Unraveling the multiscale damping behavior of two-dimensional layered MXene” published in Nanomaterials and Energy journal
2. **Outstanding Ph.D. Graduate Award** (College of Engineering and Computing, Florida International University, Miami, August 2020): Awarded for the quality and impact of my research, service, mentorship, college activities and involvement in professional societies
3. **Dissertation Year Fellowship** (University Graduate School, Florida International University, Miami, Spring 2020):
Awarded to doctoral students with notable publication record to facilitate the timely completion of high-quality manuscripts and dissertation
4. **Henry DeWitt Smith Scholarship, American Institute of Mining, Metallurgical, and Petroleum Engineers** (TMS Awards Ceremony, San Antonio, Texas, March 2019): Awarded annually to 2 graduate students in mining, metallurgical and petroleum departments of leading colleges and universities
5. **TMS Best Paper Contest - Graduate Division - First Place** (TMS Awards Ceremony, San Antonio, Texas, March 2019):
Awarded for the research article on “Real Time Observation of Splat Sliding in Cold Sprayed Metallic Coating by *In-situ* Mechanical Investigations”

6. **Presidential Award, 2019 Outstanding Student Life Awards** (*Division of Academic and Student Affairs, Florida International University, Miami, Florida, April 2019*): In recognition of strong leadership and action towards enhancing university prestige and creating positive change in the community beyond campus
7. **SMEC Student Prize 2019** (*Study of matter at extreme conditions meeting, April 2019*): Awarded for the oral presentation titled, "Graphene Foam for Engineering Ultra-Stiff, Tough and Impact-Resistant Structural Composites".
8. **Graduate Excellence in Materials Science (GEMS) Award, The American Ceramic Society - Basic Science Division** (*MS&T Technical Meeting, Columbus, Ohio, October 2018*): This award recognizes the outstanding scientific and academic achievements of graduate students in Materials Science and Engineering.
9. **TechConnect Defense Innovation Award** (*Defense TechConnect Summit, Tampa, Florida, October 2018*): Awarded for the technology submission entitled "Boron Nitride Nanotube Based Advanced Metal Matrix Nanocomposites for Aerospace Applications". This award recognizes the top 15% of technology submissions to Defense TechConnect Summit & Expo.
10. **Winner, TMS Graduate Student Poster Contest, Functional Materials Division** (*TMS Annual Meeting, Phoenix, Arizona, March 2018*): Awarded for a research poster on high-temperature oxidative unzipping of boron nitride nanotubes
11. **Second Place, TMS Best Student Oral Presentation** (*TMS Annual Meeting & Exhibition, San Antonio, Texas, March 2019*): Awarded for the presentation entitled "Real-time Deformation Mechanisms of Advanced Nanocomposites by High-Resolution In-situ Testing" in Advanced Real Time Imaging Symposium at TMS Annual Meeting & Exhibition.
12. **Second Place, Perfect Pitch Competition** (*CELL-MET Engineering Research Center, Boston University, Boston, Massachusetts, March 2019*): For my 90 seconds pitch on mechanics and materials considerations in cardiac tissue engineering. As a finalist, I represented the CELL-MET ERC at the National competition during National Science Foundation-ERC Biennial Meeting in Washington, DC in October 2019.
13. **First position in Engineering Poster Presentation at the Florida Statewide Graduate Student Research Symposium, University of South Florida** (*Tampa, Florida, April 2017*): Awarded for a research poster entitled 'Oxidative unzipping and transformation of boron nitride nanotubes into 'white graphene oxide' platelets'
14. **First Position in Oral Presentation Competition at Graduate Scholarly Forum, Florida International University** (*Graduate Student Appreciation Week, Miami, Florida, March 2016*): Awarded for a research presentation entitled "Micro and nanoscale mechanical properties of magnesium and its alloys"
15. **Presidential Fellowship, Florida International University, Miami (2015)**: Awarded by FIU-Graduate School for a period of 3 years (2015-2018) for pursuing Doctoral studies in the Department of Mechanical & Materials Engineering, College of Engineering & Computing
16. **Proficiency Medal for Best Senior Year Project in Mechanical Engineering (2015)**: Awarded for my senior year research project entitled 'Nanoindentation based creep in Magnesium alloys'
17. **IASc-INSA-NASI Summer Research Fellowship (2013)**: Jointly awarded by the Indian Academy of Science (Bangalore), Indian National Science Academy (New Delhi), and National Academy of Sciences of India (Allahabad) for pursuing summer research internship.
Host Scientist: Dr. Anjana Dogra, National Physical Laboratory, New Delhi.

JOURNAL PUBLICATIONS

1. C. Michas, M. C. Karakan, Pranjal Nautiyal, J. G. Seidman, C. E. Seidman, A. Agarwal, K. Ekinci, J. Eyckmans, A. E. White, C. S. Chen, Engineering a living cardiac pump on a chip using high-precision fabrication, **Science Advances** 8, eabm3791 (2022).
2. Pranjal Nautiyal, V. Wiedorn, T. Thomas, N. Bacca, A. White, A. Agarwal, Unraveling Mechanisms Governing Anisotropy in Accordion-shaped Honeycomb Microlattice Fabricated by Two-Photon Polymerization, **Advanced Engineering Materials** 24, 2101190 (2022).
3. Pranjal Nautiyal, C. Zhang, B. Boesl, A. Agarwal, Interfacial deformation and failure mechanisms at the single-splat length scale revealed in-situ by indentation of cold sprayed aluminum microparticles, **Materials Science & Engineering**

A 824, 141828 (2021).

4. T. Paul, *Pranjal Nautiyal*, C. Zhang, B. Boesl, A. Agarwal, Role of in-situ splat sintering on elastic and damping behavior of cold sprayed aluminum coatings, **Scripta Materialia** 204, 114125 (2021).
5. *Pranjal Nautiyal*, N. Denis, T. Dolmetsch, C. Zhang, B. Boesl, A. Agarwal, Interface Engineering and Direct Observation of Strengthening Behavior in Field-Sintered Boron Nitride Nanotube-Magnesium Alloy Composite, **Advanced Engineering Materials** 22, 2000170 (2020).
6. T. Thomas, A. Rubfiaro, *Pranjal Nautiyal*, R. Brooks, D. Dickerson, J. He, A. Agarwal, Extrusion 3D Printing of Porous Silicone Architectures for Engineering Human Cardiomyocyte-Infused Patches Mimicking Adult Heart Stiffness, **ACS Applied Bio Materials** 3, 5865 (2020).
7. X. Lu, *Pranjal Nautiyal*, J. Bustillos, A. Loganathan, C. Zhang, Y. Chen, B. Boesl, A. Agarwal, Hydroxylated boron nitride nanotube-reinforced polyvinyl alcohol nanocomposite with simultaneous improvement of mechanical and thermal properties, **Polymer Composites** 41, 5182 (2020).
8. C. Young, C. Zhang, A. Loganathan, *Pranjal Nautiyal*, B. Boesl, and A. Agarwal, Densification and Oxidation Behavior of Spark Plasma Sintered Hafnium Diboride-Hafnium Carbide Composite, **Ceramics International** 46, 14625 (2020).
9. J. Bustillos, X. Lu, *Pranjal Nautiyal*, C. Zhang, B. Boesl, A. Agarwal, Boron Nitride Nanotube Reinforced Titanium Composite with Controlled Interfacial Reactions by Spark Plasma Sintering, **Advanced Engineering Materials** 22, 2000702 (2020).
10. *Pranjal Nautiyal*, C. Zhang, V. K. Champagne, B. Boesl, A. Agarwal, In-situ creep deformation of cold-sprayed aluminum splats at elevated temperatures, **Surface & Coatings Technology** 372, 353-360 (2019).
11. *Pranjal Nautiyal*, C. Zhang, A. Loganathan, B. Boesl, A. Agarwal, High-Temperature Mechanics of Boron Nitride Nanotube “Buckypaper” for Engineering Advanced Structural Materials, **ACS Applied Nanomaterials** 2, 4402-4416 (2019).
12. S. Bhusal, C. Zhang, J. Bustillos, *Pranjal Nautiyal*, B. Boesl, A. Agarwal, A Computational Approach for Predicting Microstructure and Mechanical Properties of Plasma Sprayed Ceramic Coatings from Powder to Bulk, **Surface & Coatings Technology** 374, 1 (2019).
13. T. Thomas, C. Zhang, *Pranjal Nautiyal*, B. Boesl, A. Agarwal, 3D Graphene Foam Reinforced Low-Temperature Ceramic with Multifunctional Mechanical, Electrical, and Thermal Properties, **Advanced Engineering Materials** 21, 1900085 (2019).
14. A. Loganathan, *Pranjal Nautiyal*, B. Boesl, A. Agarwal, Unraveling the Multiscale Damping Properties of 2D Layered MXene, **Nanomaterials and Energy** 8, 84 (2019).
15. *Pranjal Nautiyal*, M. Mujawar, B. Boesl, A. Agarwal, In-situ Mechanics of 3D Graphene Foam Based Ultra-stiff and Flexible Metallic Metamaterial, **Carbon** 137, 502 (2018).
16. *Pranjal Nautiyal*, C. Zhang, B. Boesl, A. Agarwal, Non-Equilibrium Wetting and Capture of Boron Nitride Nanotubes in Molten Aluminum During Plasma Spray, **Scripta Materialia** 151, 71 (2018).
17. *Pranjal Nautiyal*, B. Boesl, A. Agarwal, The Mechanics of Energy Dissipation in a Three-Dimensional Graphene Foam with Macroporous Architecture, **Carbon** 132, 59 (2018).
18. *Pranjal Nautiyal*, C. Zhang, V. K. Champagne, B. Boesl, A. Agarwal, In-situ Mechanical Investigation of the Deformation of Splat Interfaces in Cold-Sprayed Aluminum Alloy, **Materials Science & Engineering A** 737, 297 (2018).
19. L. Fontoura, *Pranjal Nautiyal**, A. Loganathan, B. Boesl, A. Agarwal, Nacre-Inspired Graphene/Metal Hybrid by In-situ Cementation Reaction and Joule Heating, **Advanced Engineering Materials** 20, 1800518 (2018). [*Co-First Author with Luiza Fontoura]
20. A. Idowu, *Pranjal Nautiyal*, L. Fontoura, A. Loganathan, B. Boesl, A. Agarwal, Multi-Scale Damping of Graphene Foam-Based Polyurethane Composites Synthesized by Electrostatic Spraying, **Polymer Composites** 40, E1862 (2018).
21. M. Antillon, *Pranjal Nautiyal*, A. Loganathan, B. Boesl, A. Agarwal, Strengthening in Boron Nitride Nanotube Reinforced Aluminum Composites Prepared by Roll Bonding, **Advanced Engineering Materials** 20, 1800122 (2018).

22. T. Thomas, C. Zhang, A. Sahu, *Pranjal Nautiyal*, A. Loganathan, T. Laha, B. Boesl, A. Agarwal, Effect of graphene reinforcement on the mechanical properties of Ti₂AlC ceramic fabricated by spark plasma sintering, **Materials Science & Engineering A** 728, 45 (2018).
23. *Pranjal Nautiyal*, B. Boesl, A. Agarwal, Harnessing three dimensional anatomy of graphene foam to induce superior damping in hierarchical polyimide nanostructures, **Small** 13, 1603473 (2017).
24. *Pranjal Nautiyal*, A. Gupta, S. Seal, B. Boesl, A. Agarwal, Reactive wetting and filling of boron nitride nanotubes by molten aluminum during equilibrium solidification, **Acta Materialia** 126, 124 (2017).
25. L. Embrey, *Pranjal Nautiyal*[#], A. Loganathan, A. Idowu, B. Boesl, A. Agarwal, 3D graphene foam induces multifunctionality in epoxy nanocomposites by simultaneous improvement in mechanical, thermal and electrical properties, **ACS Applied Materials & Interfaces** 9, 39717 (2017). [#Co-First Author with Leslie Embrey]
26. *Pranjal Nautiyal*, L. Embrey, B. Boesl, A. Agarwal, Multi-scale mechanics and electrical transport in a free-standing 3D architecture of graphene and carbon nanotubes fabricated by pressure assisted welding, **Carbon** 122, 298 (2017).
27. J. Bustillos, D. Montero, *Pranjal Nautiyal*, A. Loganathan, B. Boesl, A. Agarwal, Integration of graphene in poly (lactic) acid by 3D printing to develop creep and wear-resistant hierarchical nanocomposites, **Polymer Composites** 39, 3877 (2017).
28. A. Loganathan, A. Sharma, C. Rudolf, C. Zhang, *Pranjal Nautiyal*, S. Suwas, B. Boesl, A. Agarwal, In-situ deformation mechanism and orientation effects in sintered 2D boron nitride nanosheets, **Materials Science & Engineering A** 708, 440 (2017).
29. *Pranjal Nautiyal*, A. Loganathan, R. Agrawal, B. Boesl, C. Wang, A. Agarwal, Oxidative unzipping and transformation of high aspect ratio boron nitride nanotubes into white graphene oxide platelets, **Scientific Reports** 6, 29498 (2016).
30. *Pranjal Nautiyal*, C. Rudolf, A. Loganathan, C. Zhang, B. Boesl, A. Agarwal, Directionally aligned ultra-long boron nitride nanotube induced strengthening of aluminum-based sandwich composite, **Advanced Engineering Materials** 18, 1747 (2016).
31. *Pranjal Nautiyal*, J. Jain, A. Agarwal, Influence of microstructure on scratch induced deformation mechanisms in AZ80 magnesium alloy, **Tribology Letters** 61, 29 (2016).
32. *Pranjal Nautiyal*, J. Jain, A. Agarwal, Influence of Loading Path and Precipitates on Indentation Creep Behavior of Mg-6 wt.%Al-1 wt.%Zn, **Materials Science & Engineering A** 650, 183 (2016).
33. K. Sambhava, *Pranjal Nautiyal*, J. Jain, Model based phenomenological and experimental investigation of nanoindentation creep in pure Mg and AZ61 alloy, **Materials & Design** 105, 142 (2016).
34. *Pranjal Nautiyal*, J. Jain, A. Agarwal, A Comparative Study of Indentation Induced Creep in Pure Magnesium and AZ61 Alloy, **Materials Science & Engineering A** 630, 131 (2015).
35. *Pranjal Nautiyal*, M. M. Seikh, O. Lebedev, A. K. Kundu, Sol-Gel Synthesis of Fe-Co Nanoparticles & Magnetization Study, **Journal of Magnetism and Magnetic Materials** 377, 402 (2015).
36. *Pranjal Nautiyal*, M. M. Seikh, V. Pralong, A. K. Kundu, Influence of bismuth on the magnetic & electrical properties of La₂MnNiO₆, **Journal of Magnetism and Magnetic Materials** 347, 111 (2013).
37. A. K. Kundu, M. M. Seikh, *Pranjal Nautiyal*, Bismuth Centred Magnetic Perovskites: A Projected Multiferroic, **Journal of Magnetism and Magnetic Materials** 378, 506 (2014).
38. V. K. Jha, *Pranjal Nautiyal*, M. M. Seikh, R. Chatterjee, R. Mahendiran, A. K. Kundu, Heat capacity, thermopower and magnetoresistance effects in multiferroic La_{0.5}Bi_{0.5}Mn_{0.5}Fe_{0.5}O₃, **Journal of Materials Science** 48, 7629 (2013).

BOOK

Pranjal Nautiyal, B. Boesl, A. Agarwal, [In-situ Mechanics of Materials: Principles, Tools, Techniques and Applications](#), Springer International Publishing, DOI: 10.1007/978-3-030-43320-8 (2020).

PATENTS

1. A. Agarwal, B. Boesl, **P. Nautiyal**, C. Rudolf, C. Zhang, *Aluminum Boron Nitride Nanotube Composites and Method for Making the Same*, US 11,148,201 B2 (Granted in 2021).
2. A. Agarwal, **P. Nautiyal**, B. Boesl, *Boron Nitride Nanotube-Magnesium Alloy Composites and Manufacturing Methods Thereof*, US 10,947,607 B1 (Granted in 2021).
3. A. Agarwal, B. Boesl, A. Idowu, **P. Nautiyal**, J. Bustillos, *Shape Memory-Based Self-Healing Polymer Composite Reinforced with Graphene Foam*, US 11,059,948 B2 (Granted in 2021).
4. A. Agarwal, T. Paul, C. Zhang, **P. Nautiyal**, *Metal Nanoparticle Composites and Manufacturing Methods Thereof by Ultrasonic Casting*, US 10,941,464 B1 (Granted in 2021).
5. A. Agarwal, B. Boesl, C. Zhang, T. Thomas, **P. Nautiyal**, *Method to Produce Graphene Foam Reinforced Low Temperature Co-fired Ceramic (LTCC) Composite*, US 10,807,915 B1 (Granted in 2020).

PRESENTATIONS IN CONFERENCES AND RESEARCH MEETINGS

1. *Accepted abstract*: Studying mechanochemical reactions at mixed sliding-rolling contacts, **ACS Fall 2022**, Chicago, Illinois, USA (August 2022).
2. *Accepted abstract*: Metal oxide nanocrystal anti-wear additives: Tribosintering vs. tribochemistry at lubricated sliding/rolling contacts, **Tribology Gordon Research Seminar**, Maine, USA (June 2022).
3. Uncovering Mechanochemical Pathways to Obtaining Low Friction, Anti-wear Lubricants by In-situ Atomic Force Microscopy, **STLE Annual Meeting**, Orlando, Florida, USA (May 2022).
4. Real Time Imaging of Deformation Mechanisms in Boron Nitride Nanotube-Metal Matrix Composites at Multiple Length Scales, **TMS Annual Meeting & Exhibition**, San Diego, California, USA (February 2020).
5. In-situ Study of Multi-Scale Deformation in Two-photon Polymerized Microlattices, **MS&T Technical Meeting & Exhibition**, Portland, Oregon, USA (October 2019).
6. Determination of Bonding Strength of Cold Sprayed Splats Using In-situ Nano-scratch Technique, **MS&T Technical Meeting & Exhibition**, Portland, Oregon, USA (October 2019).
7. Mechanics of Cold Sprayed Materials: From Splats to Coatings, **Cold Spray Action Team**, Boston, Massachusetts, USA (June 2019).
8. Graphene Foam-Based Multifunctional Polymer Composites for Self-Healing, De-icing and Strain-sensing Applications, **Study of matter at extreme conditions**, Miami-Caribbean Cruise (April 2019).
9. Graphene Foam for Engineering Stiff, Tough and Impact-Resistant Structural Composites, **Study of matter at extreme conditions**, Miami-Caribbean Cruise (April 2019).
10. Real Time Deformation Mechanisms of Advanced Nanocomposites by High-Resolution In-situ Testing, **TMS Annual Meeting & Exhibition**, San Antonio, Texas, USA (March 2019).
11. Real-time Deformation in Cold Sprayed Aluminum Alloy at Elevated Temperatures by In Situ Nanoindentation, **TMS Annual Meeting & Exhibition**, San Antonio, Texas, USA (March 2019).
12. Scalable Nanomanufacturing Approaches to Develop Advanced Metal Matrix Nanocomposites, **TMS Annual Meeting & Exhibition**, San Antonio, Texas, USA (March 2019).
13. In-situ Investigation of Thermo-Mechanical Properties of a Free-standing Boron Nitride Nanotube Buckypaper, **TMS Annual Meeting & Exhibition**, San Antonio, Texas, USA (March 2019).
14. Multi-Scale Mechanics of 3D Printed Honeycomb Structures for Cardiac Tissue Engineering, **22nd Annual Boston University Photonics Center Symposium on Frontiers of Cardiac Tissue Engineering**, Boston, Massachusetts, USA (November 2018).
15. Scalable Manufacturing Routes to Develop Boron Nitride Nanotubes Based Metal Matrix Composites, **International Mechanical Engineering Congress & Exposition**, Pittsburgh, Pennsylvania, USA (November 2018).

16. 3D Graphene Foam for Engineering Advanced Composites and Metamaterials, **International Mechanical Engineering Congress & Exposition**, Pittsburgh, Pennsylvania, USA (November 2018).
17. Boron Nitride Nanotube Based Advanced Metal Matrix Nanocomposites for Aerospace Applications, **Defense TechConnect**, Tampa, Florida, USA (October 2018).
18. Integrating Boron Nitride Nanotubes in Aluminum for Superior Mechanical Properties (Poster), **MS&T Technical Meeting & Exhibition**, Columbus, Ohio, USA (October 2018).
19. In-situ Mechanics of a Super-lightweight and Ultra-stiff 3D Graphene-Metal Metamaterial, **MS&T Technical Meeting & Exhibition**, Columbus, Ohio, USA (October 2018).
20. Scalable Manufacturing of Boron Nitride Nanotube Based Metal Matrix Composites, **14th International Ceramics Congress**, Perugia, Umbria, Italy (June 2018).
21. In situ Mechanical Investigation of Splat Sliding in Cold Sprayed 6061Al Coatings, **International Thermal Spray Conference 2018**, Orlando, Florida, USA (May 2018).
22. Pathways for Engineering Boron Nitride Nanotube Based High-Strength Metal Matrix Composites, **AeroMat 2018**, Orlando, Florida (May 2018).
23. *In Situ* Deformation Characteristics of a Free-standing Three-dimensional Graphene Foam-aluminum Nanohybrid, **TMS Annual Meeting & Exhibition**, Phoenix, Arizona, USA (March 2018)
24. Boron Nitride Nanotube Based High-strength Aluminum Composites (Poster), **TMS Annual Meeting & Exhibition**, Phoenix, Arizona, USA (March 2018)
25. Boron nitride nanotube reinforced aluminum composite via solidification processing, **MS&T Technical Meeting & Exhibition**, Pittsburgh, Pennsylvania, USA (Oct 2017)
26. Boron Nitride Nanotube Induced Strengthening of Lightweight Aluminum Composite for Fuel-Efficient Aerospace & Automotive Structures, **NanoFlorida 2017**, Miami, Florida, USA (Sept 2017)
27. Splat sliding in cold-sprayed coatings (Poster), **Cold Spray Action Team**, Boston, Massachusetts, USA (June 2017)
28. Oxidative unzipping and transformation of boron nitride nanotubes into ‘white graphene oxide’ platelets (Poster), **Florida Statewide Graduate Research Symposium**, Tampa, Florida, USA (April 2017)
29. Multi-scale mechanics and electrical transport in a free-standing 3D architecture of graphene and carbon nanotubes fabricated by pressure assisted welding, **Study of Matter at Extreme Conditions**, Miami-Eastern Caribbean (April 2017)
30. High temperature transformations in boron nitride nanotubes, **MS&T Technical Meeting & Exhibition**, Salt Lake City, Utah, USA (Oct 2016)
31. Nano-scale creep and scratch-induced deformation in Mg alloys (Poster), **Florida Statewide Graduate Research Symposium**, Gainesville, Florida, USA (April 2016)

HANDS-ON EXPERIENCE

Nanoindentation, Atomic and Friction Force Microscopy (AFM/FFM), Focused Ion Beam (FIB) machining/ imaging, Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS), Mini-Traction Machine/ Spacer Layer Imaging (MTM/SLIM) ball-on-disc tribometer, Scanning Electron Microscopy (SEM), Electron Dispersive Spectroscopy (EDS), X-ray Diffraction (XRD), White Light Interferometry (WLI), Micro- and Meso-scale mechanical Testing, *In-situ* SEM Mechanical Testing, High-temperature Mechanical Testing, Powder metallurgy, Sol-gel synthesis

RESEARCH PROJECTS

1. **Protective Coatings that Manufacture Themselves for High Performance Applications** (Oct 2020 – present)
My role in the project: Using in-situ optical, scanning probe and surface analytical techniques to interrogate tribosintering of nanoparticles and their interactions with lubricant additives at sliding and rolling interfaces
 PI: Prof. Robert W. Carpick (UPenn)

Sponsor: Department of Energy

Collaborations: Pixelligent Technologies LLC, Argonne National Lab, Exxon Mobil Corp., Lanxess, University of Akron

2. **NSF Center for the Mechanical Control of Chemistry** (Feb 2022 – present)
My role in the project: Study of organic reactions under applied force by scanning probe and elasto-hydrodynamic approaches
PI: Prof. Robert W. Carpick (UPenn)
Sponsor: National Science Foundation
Collaboration: Prof. A. Braunschweig (City University of New York)
3. **Study of mechanochemical interactions between ZDDP and MoDTC additives in lubricants** (Dec 2020 – Aug 2021)
My role in the project: In-situ study of tribofilm formation and boundary friction by atomic force microscopy to develop insights for designing low viscosity lubricants with superior anti-wear and friction performance
PI: Prof. Robert W. Carpick (UPenn)
Sponsor/ Collaborator: Idemitsu Kosan Co., Idemitsu Lubricants America Corporation
4. **Splat Sliding in Cold Sprayed Coatings** (Sept 2016 – Sept 2020)
My role in the project: Interrogation of mechanical properties, interface adhesion and deformation mechanisms exhibited by cold sprayed metallic coatings at multiple length scales
Output: 3 journal publications as first author
PIs: Prof. Arvind Agarwal, Prof. Benjamin Boesl (FIU)
Sponsor: Army Research Lab
Collaboration: Dr. Victor Champagne (Army Research Laboratory)
5. **Boron Nitride Nanotube Reinforced Metal Matrix Composites** (Aug 2015 – Sept 2020)
My role in the project: Microstructure engineering and study of strengthening mechanisms exhibited by boron nitride nanotube-reinforced Ti/ Mg/ Al composites using in-situ micromechanical approaches
Output: 5 journal publications as first author, 2 US Patents
PIs: Prof. Arvind Agarwal, Prof. Benjamin Boesl (FIU)
Collaboration: Prof. Sudipta Seal's group (University of Central Florida)
6. **Nanosystems Engineering Research Center for Directed Multiscale Assembly of Cellular Metamaterials with Nanoscale Precision** (CELL-MET), A NSF Research Center (Nov 2017 – Sept 2020)
My role in the project: Study of the mechanics of micro-devices and 3D printed micro-scaffolds for cardiac bioengineering
Output: 1 journal publication as first author
PI: Prof. Arvind Agarwal (FIU)
Sponsor: National Science Foundation
Collaborations: Prof. A. White (Boston University), Prof. C. Chen (Boston University)
7. **3D Graphene Foam Reinforced Flexible Polymer Composite** (Jan 2016 – July 2018)
My role in the project: Investigation of mechanical properties and failure mechanisms by micromechanical testing approaches
Output: 3 journal publications as first author, 3 journal publications as a contributing author, 1 US Patent
PIs: Prof. Arvind Agarwal, Prof. Benjamin Boesl (FIU)
Sponsor: Army Research Office
8. **Nanoscale plasticity in magnesium alloys** (May 2014 – Aug 2015)
My role in the project: Study of creep (time-dependent deformation) in Mg alloys by nanoindentation technique
Output: 3 journal publications as first author

PIs: Prof. Arvind Agarwal (FIU), Prof. Jayant Jain (IIT Delhi)

9. **Synthesis and study of magnetic perovskites** (Dec 2012 – May 2015)

My role in the project: Sol gel synthesis and sintering of Bi-based perovskites

Output: 2 journal publications as first author, 2 journal publications as a contributing author

PI: Prof. Asish K. Kundu (IIIT Jabalpur)

TEACHING AND MENTORSHIP

- **Assistant Instructor**, Nanotribology (MEAM 537), Spring 2022

Mechanical Engineering and Applied Mechanics Department, University of Pennsylvania
Course Instructor: Prof. Robert W. Carpick

Lectures delivered:

1. Adhesive contact mechanics
2. Boundary lubrication and anti-wear tribofilms

Hands-on laboratory sessions organized:

1. Characterization of surface roughness by AFM
2. ZDDP tribofilm formation at single asperity nanocontacts

- I collaborated with my PhD advisor to develop a 14-lecture, short summer course on “*Thermal Sprayed Coatings and Composites*”. Some of these lectures now constitute a portion of an expanded, full-semester course on *Materials Processing (EMA 5605)* offered by the Department of Mechanical and Materials Engineering at FIU.
- Taught a section of the *Materials Processing (EMA 5605)* course offered by the Mechanical and Materials Engineering department at FIU in Spring 2020.

Lectures delivered:

1. Fundamentals of cold spray deposition technique
2. Mechanical behavior of cold sprayed coatings

- Conducted hands-on laboratory and project components of the *Nanomechanics and Nanotribology (EMA 5200)* course offered by the Mechanical and Materials Engineering department at FIU

Course Instructor: Prof. Arvind Agarwal

- Mentorship of undergraduate students:

1. Mr. Michael Moriarty, Undergraduate Student (University of Pennsylvania), Vagelos Integrated Program in Energy Research program (Summer 2022)

Project: Study of tribochemical and tribosintering reaction mechanisms

2. Mr. Kueyoung Kim, Undergraduate Student (Pennsylvania State University), Center for the Mechanical Control of Chemistry Research Experience for Undergraduates Program (Summer 2022)

Project: Mechanical control of organic reactions

3. Ms. Noemie Denis, Undergraduate Student, Mechanical Engineering (Florida International University)

Project: Magnesium-Boron Nitride Nanotube Composites: Evaluating Microstructure Evolution and Mechanical Properties (Spring 2019 – Spring 2020)

Output: 1 journal manuscript, 1 conference poster by Noemie Denis as the first author

4. Mr. William Schertzer, Undergraduate Student (Georgia Institute of Technology), CELL-MET Research Experience for Undergraduates Program (Summer 2019)

Project: Dispersion and Integration of Boron Nitride Nanotubes in Pentaerythritol Triacrylate for Direct Laser Writing of Composite Microlattices

Output: 1 poster

5. Ms. Melania Antillon, Undergraduate Student, Mechanical Engineering (Florida International University)
Project: Fabrication and Mechanical Testing of Aluminum-Boron Nitride Nanotube Composites by Roll-bonding Technique (Fall 2016 – Fall 2017)
Output: 1 journal paper, 1 conference poster by Melania Antillon as the first author

OUTREACH

- **High School Apprenticeship and Undergraduate Research Apprenticeship Program (HSAP/URAP), 2018**: I co-authored a proposal to secure funding from the Army Research Office to host 1 high school student and 1 undergraduate student in the Plasma Forming Lab (FIU) for hands-on research experience
Proposal title: Mechanical Properties of Origami-Inspired Graphene Foam-Polymer Composites
Selected for funding in 2018 (PIs: Prof. Arvind Agarwal, Prof. Benjamin Boesl)
Participating students: Ms. Connie Ly, Mr. Arturo Toro
- Laboratory demonstrations and presentations in the **Engineering Expo** (2016, 2017, 2018, 2019), which is attended by over 1,500 Miami Dade school students. The Expo takes place in the Engineering Center of FIU in Spring every year to expose and inspire students to pursue a career in STEM disciplines.
- Directed an educational video for **2021 Virtual Philly Materials Day**, titled “Tribology: Principles of Friction, Adhesion, Wear, and Lubrication” ([link](#))

SERVICE AND LEADERSHIP

- **Co-organizer, Symposium on advanced real time imaging, TMS2022 Annual Meeting & Exhibition**, Anaheim, California (Feb 27 – March 3, 2022)
- **Session Chair, Symposium on Surface Interactions in Materials – Chemical and Physical Interactions, TMS2018 Annual Meeting & Exhibition**, Phoenix, Arizona (March 11-15, 2018)
- **Reviewer to International Journals**: Nanoscale (Royal Society of Chemistry), Small (Wiley), ACS Applied Nanomaterials (American Chemical Society), ACS Applied Materials & Interfaces (American Chemical Society), Physical Review Applied (American Physical Society), Review of Scientific Instruments (AIP Publishing), Tribology Letters (Springer), ACS Sustainable Chemistry & Engineering (American Chemical Society), Tribology International (Elsevier), Surface and Coatings Technology (Elsevier), Journal of Manufacturing Science and Engineering (ASME), Advanced Engineering Materials (Wiley), Molecular Systems Design & Engineering (Royal Society of Chemistry), Metallurgical and Materials Transactions A (Springer), Computational Materials Science (Elsevier), Advanced Electronic Materials (Wiley), Materials Chemistry and Physics (Elsevier), New Journal of Chemistry (Royal Society of Chemistry)
- **Industry Outreach**: Represented the Innovation Ecosystem Thrust of [CELL-MET](#) Engineering Research Center at TERMIS Conference in Kyoto, Japan (September 4-7, 2018) to establish a partnership with industries in the area of biomedicine and tissue engineering.
- **Member, Student Advisory Board, Advanced Materials Engineering Research Institute (AMERI) at FIU** (Aug 2017 – July 2018)
- **Chair, Material Advantage FIU Chapter** (May 2017-July 2018)
- **Secretary, Council for Student Organizations, FIU** (May 2017-May 2018)
- **Secretary, Material Advantage FIU Chapter** (Aug 2015 – April 2017)
- **FIU Commencement Ambassador** (2017): Student volunteer in the commencement ceremony of FIU
- **Membership in Professional Societies**: Society of Tribologists and Lubrication Engineers (2020-present), American Society of Mechanical Engineers (2018-2020), Material Advantage Student Program (2015-2020), which is affiliated to ACerS (The American Ceramic Society), AIST (Association for Iron & Steel Technology), ASM International (The Materials Information Society) and TMS (The Minerals, Metals and Materials Society)

MEDIA COVERAGE

- Our research on fabrication and mechanical investigations on a bioinspired multi-layer metal-graphene composite was featured in **Advanced Science News**: [Mother of Pearl Inspires Next Generation of Strong and Tough Materials](#)
- Feature article by the Department of Mechanical and Materials Engineering Department (FIU) [Pranjal Nautiyal: Shining Graduate Scholar Receives Prestigious Awards](#)
- Presidential Award at the 2019 Outstanding Student Life Awards: [FIU celebrates outstanding students at annual award ceremony](#)
- Nanomaterials and Energy Prize for our research article on damping behavior of MXene: [ICE Publishing Awards 2020](#)
- AIME Henry DeWitt Smith Scholarship and TMS Best Paper Awards in the annual meeting of the Metals, Minerals and Materials Society: [TMS Honors 2019 Awardees](#)