

**The 6<sup>th</sup> “Multifunctional Materials for Defense”  
Workshop**

**Theme:**

**Disruptive Multifunctional Systems for Demanding  
Environments: New Thrusts into Space**

***Incorporating:***

**The 2022 Annual Grantees’/Contractors’ Meeting for  
AFOSR Program on “Mechanics of Multifunctional  
Materials & Microsystems”**

**The 2022 Annual Review for  
ARO Program on “Mechanical Behavior of Materials”**

**The 2022 Annual Review for  
ONR Program on “Multifunctional Materials &  
System Health Management”**

**5-9 December 2022**

**4100 North Fairfax Drive, Suite 450**

**Basic Research Innovation & Collaboration Center**

**Arlington, VA 22203**

**SPONSORED BY:**



### **Workshop Co-Chairs:**

James Joo (Air Force Research Lab)  
Victoria Blair (Army Research Lab)  
Keith Perkins (Naval Research Lab)

### **Joint Organizing Committee:**

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B.-L. ("Les") Lee (Air Force Office of Scientific Research), **Co-Chair**  
Ignacio Perez de Leon (Office of Naval Research), **Co-Chair**

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Philip Buskohl (Air Force Research Lab - RXAS)  
Matthew Dickerson (Air Force Research Lab - RXCC)  
Ben Dickinson (Air Force Research Lab - RWWN)  
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Ajit Roy (Air Force Research Lab - RXAN), **ex officio**  
Lisa Rueschhoff (Air Force Research Lab - RXCCM)  
Joe Van Nostrand (Air Force Research Lab - RITB)

Victoria Blair (Army Research Lab), **Workshop Co-Chair '22**  
Robert Haynes (Army Aviation & Missile Center)  
Todd Henry (Army Research Lab)  
Dan Magagnosc (Army Research Lab)  
Amanda Napier (Army Aviation & Missile Center)  
Joey Palomba (Army Soldier Center)  
Thomas Plaisted (Army Research Lab)  
Katie Sebeck (Army Ground Vehicle System Center)  
Gabriel Smith (Army Research Lab), **ex officio**

Peter Finkel (Naval Research Lab)  
Matthew Laskoski (Naval Research Lab)  
Keith Perkins (Naval Research Lab), **Workshop Co-Chair '22**  
Logan Richardson (Naval Research Lab)

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Qing Wu (Air Force Research Lab - RI)

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Daniel O'Brien (Army Research Lab), **ex officio**  
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William Baron (Air Force Research Lab), **ex officio**  
Jeffery Baur (Univ. of Illinois, Urbana-Champaign; formerly Air Force Research Lab), **ex officio**  
  
Larry Holmes (Army Research Lab)  
William Nothwang (Army Research Lab), **ex officio**  
Shawn Walsh (Army Research Lab), **ex officio**

### **Keynote Speaker:**

Bill Carter (Defense Advanced Research Projects Agency)  
Andrew Detor (Defense Advanced Research Projects Agency)

### **Technology Transition Showcase Speakers:**

Jay Kudva (NextGen Aeronautics)  
Jerry Meyer (Naval Research Lab)  
Kathleen Richardson (Univ. of Central Florida)

### **Speakers, PI's & Co-PI's (Non-Government):**

#### ***AFOSR PI's/Co-PI's (FY22):***

Leif Asp (Chalmers Univ. of Technology, *Sweden*)  
Ray Baughman (Univ. of Texas at Dallas)  
Jeffery Baur (Univ. of Illinois, Urbana-Champaign)  
Will Boley (Boston Univ.)  
Frank Chang (Univ. of California, Los Angeles)  
Fu-Kuo Chang (Stanford Univ.)  
Ioannis Chasiotis (Univ. of Illinois, Urbana-Champaign)  
Yong Chen (Univ. of California, Los Angeles)  
Nikolaus Correll (Univ. of Colorado, Boulder)  
Javier del Valle (Univ. of Geneva, *Switzerland*)  
Martin Dunn (Univ. of Colorado, Denver)  
Aaron Esser-Kahn (Univ. of Chicago)  
Philippe Geubelle (Univ. of Illinois, Urbana-Champaign)  
Somnath Ghosh (Johns Hopkins Univ.)  
Emile Greenhalgh (Imperial College London, *United Kingdom*)  
Lei He (Univ. of California, Los Angeles)  
Noel Holbrook (Harvard Univ.)  
Jonathan Hopkins (Univ. of California, Los Angeles)  
Guoliang Huang (Univ. of Missouri)  
Doug Hunsaker (Utah State Univ.)  
Daniel Inman (Univ. of Michigan)  
Sung Kang (Johns Hopkins Univ.)  
Alamgir Karim (Univ. of Houston)  
David Kisailus (Univ. of California, Irvine)  
Nicholas Kotov (Univ. of Michigan)  
Walter Lacarbonara (Univ. of Rome, *Italy*)  
Giulia Lanzara (Univ. of Rome, *Italy*)  
David Lentink (Univ. of Groningen, *The Netherlands*)  
Kurt Maute (Univ. of Colorado, Boulder)  
Majid Minary-Jolandan (Arizona State Univ.)  
Marc Miskin (Univ of Pennsylvania)  
Jeffrey Moore (Univ. of Illinois, Urbana-Champaign)  
Dave Myszka (Univ. of Dayton)  
William Oates (Florida A&M / Florida State Univ.)  
James Pikul (Univ. of Pennsylvania)  
Jerry Qi (Georgia Inst. of Technology)  
Jordan Raney (Univ. of Pennsylvania)  
Fulton Rockwell (Harvard Univ.)  
S. Andrew Sarles (Univ. of Tennessee, Knoxville)  
Robert Shepherd (Cornell Univ.)  
Nancy Sottos (Univ. of Illinois, Urbana-Champaign)  
Abraham Stroock (Cornell Univ.)  
Sameh Tawfick (Univ. of Illinois)  
Salvatore Torquato (Princeton Univ.)  
Ryan Truby (Northwestern Univ.)  
Stanley Williams (Texas A&M Univ.)  
Jianhua (Joshua) Yang (Univ. of Southern California)  
Suin Yi (Texas A&M Univ.)  
Kai Yu (Univ. of Colorado, Denver)

Pablo Zavattieri (Purdue Univ.)  
Dan Zenkert (KTH Royal Inst. of Technology, Sweden)

***ARO PI's/Co-PI's (FY22):***

Scott Banta (Columbia Univ.)  
Francois Barthelat (Univ. of Colorado)  
Shane Bartus (Transparent Armor Solutions)  
Penghui Cao (Univ. of California, Irvine)  
Andrew Croll (North Dakota State Univ.)  
Todd Emrick (Univ. of Massachusetts, Amherst)  
Robert Hovden (Univ. of Michigan)  
Guoliang Huang (Univ. of Missouri)  
Alexander Idesman (Texas Tech Univ.)  
Lou Kondic (New Jersey Inst. of Technology)  
Valery Levitas (Iowa State Univ.)  
Carmel Majidi (Carnegie Mellon Univ.)  
Vicky Nguyen (Johns Hopkins Univ.)  
Beth Opila (Univ. of Virginia)  
Xiaoqing Pan (Univ. of California, Irvine)  
Harold Park (Boston Univ.)  
Sid Pathak (Iowa State Univ.)  
Shelly Peyton (Univ. of Massachusetts, Amherst)  
Elisa Riedo (New York Univ.)  
Greg Thompson (Univ. of Alabama)  
Garritt Tucker (Colorado School of Mines)  
Chris Weinberger (Colorado State Univ.)  
Chris Yakacki (Univ. of Colorado, Denver)  
Arash Yavari (Georgia Inst. of Technology)

***ONR PI's/Co-PI's (FY22):***

Kevin Brenner (Southern Methodist Univ.)  
Yiming Deng (Michigan State Univ.)  
Victor Giurgiutiu (Univ. of South Carolina)  
Ming Han (Michigan State Univ.)  
Haiying Huang (Univ. Texas at Arlington)  
Wonmo Kang (Arizona State Univ.)  
Mehdi Kiani (Pennsylvania State Univ.)  
Sridhar Krishnaswamy (Northwestern Univ.)  
Kara Peters (North Carolina State Univ.)  
Gary Pickrell (Virginia Polytechnic Inst.)  
Shashank Priya (Pennsylvania State Univ.)

**Speakers, PI's & Co-PI's (Government):**

***AFOSR PI's/Co-PI's (FY22):***

Philip Beran (Air Force Research Lab - RQVC)  
Philip Buskohl (Air Force Research Lab - RXAS)  
Larry Drummy (Air Force Research Lab - RXAS)  
Michael Durstock (Air Force Research Lab - RXA)  
Andrew Gillman (Air Force Research Lab - RXMS)  
James Joo (Air Force Research Lab - RQVS)  
Abby Juhl (Air Force Research Lab - RXAS)  
Alex Pankonien (Air Force Research Lab - RQVC)  
Gregory Reich (Air Force Research Lab - RQVC)  
James Thomas (Naval Research Lab)

***ONR PI's/Co-PI's (FY22):***

Peter Finkel (Naval Research Lab)  
Matthew Laskoski (Naval Research Lab)  
Logan Richardson (Naval Research Lab)

**Session Chairs/Moderators:**

Richard Beblo (Air Force Research Lab - RQVC)

Philip Buskohl (Air Force Research Lab - RXAS)  
Matthew Dickerson (Air Force Research Lab - RXCC)  
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Joey Palomba (Army Soldier Center)  
Thomas Plaisted (Army Research Lab)  
Gabe Smith (Army Research Lab), **ex officio**

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Keith Perkins (Naval Research Lab), **Workshop Co-Chair '22**  
Logan Richardson (Naval Research Lab)  
James Thomas (Naval Research Lab), **ex officio**  
Caitlin Williams (Naval Research Lab)

# AGENDA

## Monday, December 5

<i><b>Time</b></i>	<i><b>Speaker</b></i>	<i><b>Title of Presentation</b></i>
<b>08:00</b>		<i>Registration</i>
<b>Session Chair: Ben Dickinson (Air Force Research Lab)</b>		
<b>08:15</b>	James Joo AFRL/RQ Victoria Blair ARL Keith Perkins NRL	<i>Opening Remarks</i>
08:30	<b>Salvatore Torquato</b> Princeton U	Extraordinary Multifunctional Disordered Composites
08:55	<b>Somnath Ghosh</b> Johns Hopkins U	Integrated Multi-Physics, Multi-scale Computational Modeling Framework for Multifunctional Applications
09:20	<b>William Oates</b> Florida A&M / Florida State U	Quantifying Complexity to Advance the Discovery and Design of Next Generation Smart Materials
<b>09:45</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Dan Magagnosc (Army Research Lab)</b>		
<b>10:00</b>	<b>Nicholas Kotov</b> U Michigan	Graph Theory of Nanoscale Framework Materials
10:25	<b>Ioannis Chasiotis</b> U Illinois	Local Multiphysics Studies in Nanostructured Materials
10:50	<b>Robert Hovden</b> U Michigan	Nanoscale Deformation Mechanics of Hierarchical Materials
11:15	<b>Shelly Peyton</b> <b>Todd Emrick</b> U Mass Amherst <b>Anna Balazs</b> U Pittsburgh	Force-Activated, Mechanically Adaptive Soft Materials: Harnessing Cryptic Bonds in Synthetic Systems
<b>11:40</b>	<b>Lunch</b>	<b>Break</b>

## **Luncheon Talk - Moderator: Gabe Smith (Army Research Lab)**

<b>12:05</b>	Vicky Nguyen Johns Hopkins U <b>Chris Yakacki</b> U Colorado Denver	<i>Newly Proposed:</i> Extreme Dissipation Behaviors of Main-Chain Liquid-Crystal Elastomers
<b>12:40</b>	<b>Matthew Laskoski</b> NRL	<i>Newly Proposed:</i> Design and Properties of High Temperature Polymers
<b>13:05</b>	<b>Coffee</b>	<b>Break</b>

<b>Session Chair: Victoria Blair (Army Research Lab)</b>		
<b>13:20</b>	<b>Larry Drummy</b> <b>Andrew Gillman</b> AFRL/RX	Elastic Wave Propagation and Plastic Energy Dissipation in Polymer Grafted Nanoparticle Assemblies through Structure Control and Hyperuniformity
13:45	<b>Somnath Ghosh</b> Johns Hopkins U <b>Jim Thomas</b> NRL	Validation of Multiscale Modeling and Design Platform for Protective Hybrid Composite Systems for Aerospace Structures
14:10	<b>Andrew Croll</b> N. Dakota State U	Guided Energy Absorption with Crumpled Polymer Sheets
14:35	<b>Valery Levitas</b> Iowa State U	New Rules of Coupled Severe Plastic Deformation, Phase Transformation, and Microstructure Evolution under High Pressure
<b>15:00</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Joey Palomba (Army Soldier Center)</b>		
<b>15:15</b>	<b>Xiaoqing Pan</b> UC Irvine	Quantitative Prediction and Observation of Grain Boundary Dynamics
15:40	<b>Francois Barthelat</b> U Colorado Boulder	Engineered Granular Crystals as Platform for New Materials, New Mechanics and New Functionalities
16:05	<b>Lou Kondic</b> New Jersey Inst. of Technology	Material Response of Granular Systems: From Understanding to Predicting
16:30	<b>Shane Bartus</b> Transparent Armor Solutions	(STTR-II) Multi-Hit Performance of Small Arms Protective Armor
16:55		<b>Wrap-up</b>
<b>17:00</b>	<b>Adjournment</b>	<b>Adjournment</b>

<b>Tuesday, December 6</b>		
<b>Time</b>	<b>Speaker</b>	<b>Title of Presentation</b>
<b>08:00</b>		<b>Registration / Housekeeping</b>
<b>Session Chair: Amanda Napier (Army Aviation &amp; Missile Center)</b>		
<b>08:15</b>	<b>Garritt Tucker</b> Colorado School of Mines <b>Sid Pathak</b> Iowa State U	Mechanistic Design of Multilayered Nanocomposites: Hierarchical Metal-MAX Materials for Tunable Strength and Toughness
08:40	<b>Beth Opila</b> U Virginia	Efficacy of Rare Earth Mineral Substances as “High Entropy” Environmental Barrier Coatings
09:05	<b>Chris Weinberger</b> Colorado State U <b>Greg Thompson</b> U Alabama	Tailored Temperature Dependent Deformation in Ultrahigh Temperature Ceramic Composites
09:30	<b>Penghui Cao</b> UC Irvine	Revealing and Tailoring Mechanical Behaviors of Multi-Principal Element Alloys Under Extreme Thermomechanical Conditions
<b>09:55</b>	<b>Coffee</b>	<b>Break</b>

<b>Session Chair: Matthew Dickerson (Air Force Research Lab)</b>		
<b>10:10</b>	<b>David Kisailus</b> UC Irvine <b>Pablo Zavattieri</b> Purdue U	Investigation of Force Transduction and Actuation in Integrated Multifunctional Biological Structures
10:35	<b>Alamgir Karim</b> U Houston	Multilayered Protective Biomimetic Coatings from Sustainable Chitin and Chitosan
11:00	<b>Scott Banta</b> Columbia U	Modulation of Enzymatic Reaction Trajectories via Applied Mechanical Forces
11:25	<b>Elisa Riedo</b> New York U	Novel Properties of Pressure-Activated 2D Materials
<b>11:50</b>	<b>Lunch</b>	<b>Break</b>

<b>Luncheon Talk - Moderator: Ajit Roy (Air Force Research Lab)</b>		
<b>12:15</b>	<b>Abraham Stroock</b> Cornell U <b>Noel Holbrook</b> <b>Fulton Rockwell</b> Harvard U	<b>Newly Proposed:</b> Plant-Inspired Thermal Metamaterials with Tunable Properties
<b>13:05</b>	<b>Coffee</b>	<b>Break</b>

<b>Session Chair: Nancy Sottos (Univ. of Illinois)</b>		
<b>13:20</b>	<b>Nancy Sottos</b> <b>Ioannis Chasiotis</b> <b>Jeffrey Moore</b> <b>Philippe Geubelle</b> <b>Jeffery Baur</b> U Illinois <b>Aaron Esser-Kahn</b> U Chicago	<b>CoE'20 in "Self-Healing, Regeneration &amp; Structural Remodeling" –</b> (i) Overview (ii) Rapid Manufacturing of Multifunctional Composites (ii) Frontal Polymerization and Phase Change Materials for Patterning (iv) Morphogenic Manufacturing of Multifunctional Materials (v) Space Manufacturing - "Function on Demand" (vi) Space Sustainability
<b>15:00</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Larry Drummy (Air Force Research Lab)</b>		
<b>15:15</b>	<b>Sung Kang</b> Johns Hopkins U	Bone-Inspired Lightweight Self-Adapting and Damage-Mitigating Materials
15:40	<b>James Pikul</b> U Penn	Room Temperature Morphogenesis of Metals
16:05	<b>Majid Minary-Jolandan</b> Arizona State U	Self-Sensing and Self-Healing Metal Matrix Composites
16:30	<b>Sameh Tawfik</b> U Illinois	(YIP) Polymorphic Hair Material Systems for Multifunctional Reconfiguration and Damage Restoration
16:55		<b>Wrap-up</b>
<b>17:00</b>	<b>Adjournment</b>	<b>Adjournment</b>



## Wednesday, December 7

<b>Time</b>	<b>Speaker</b>	<b>Title of Presentation</b>
<b>08:00</b>		<b>Registration / Housekeeping</b>
<b>Session Chair: Lisa Rueschhoff (Air Force Research Lab)</b>		
<b>08:15</b>	<b>Aaron Esser-Kahn</b> U Chicago	(PECASE) Sensing and Modulating Materials Properties Using Piezoelectric Response Elements
08:40	<b>Carmel Majidi</b> Carnegie Mellon U	Soft Intelligent Materials with Liquid Metal and Liquid Crystal Elastomer
09:05	<b>Guoliang Huang</b> U Missouri	Degenerate Torque Materials for Perfect Cloaking in Elastic Media
09:30	<b>Arash Yavari</b> Georgia Tech	Nonlinear and Linear Elastodynamics Transformation Cloaking
<b>09:55</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Philip Buskohl (Air Force Research Lab)</b>		
<b>10:10</b>	<b>Rob Shepherd</b> Cornell U <b>Nikolaus Correll</b> U Colorado Boulder	Localized and Rapid Variable Compliance Via Phase Changing Matter and Distributed Computation
10:35	<b>Jonathan Hopkins</b> UCLA	Mechanical Neural-network Architecture Materials that Learn
11:00	<b>Jordan Raney</b> U Penn	Bifurcation Based Actuation for Autonomous Smart Structures
11:25	<b>Javier del Valle</b> U Geneva	Synaptic and Neuronal Functionalities on a Single Oxide Film
<b>11:50</b>	<b>Lunch</b>	<b>Break</b>

## Luncheon Talk - Moderator: Joe Van Nostrand (Air Force Research Lab)

<b>12:15</b>	<b>Yong Chen</b> UCLA	<b>Briefing on AFOSR MURI '19:</b> "Brain-Inspired Networks for Multifunctional Intelligent Systems in Aerial Vehicles" (3 <sup>rd</sup> Annual Review at UCLA on October 24-25, 2022; <b>UCLA / U Tenn / U So Calif / Texas A&amp;M / Stanford U / U Michigan</b> ) (PI: <b>Yong Chen</b> ; Co-PIs: <b>Frank Chang, Lei He, Andy Sarles, Joshua Yang, Stanley Williams, Suin Yi, Fu-Kuo Chang, Daniel Inman</b> ) (PM: <b>Les Lee</b> ; Co-PM's: <b>Kenneth Goretta, Patrick Bradshaw, Fariba Fahroo, Hal Greenwald</b> )
<b>13:05</b>	<b>Coffee</b>	<b>Break</b>

## Session Chair: James Joo (Air Force Research Lab)

<b>13:20</b>	<b>Bill Carter</b> <b>Andrew Detor</b> DARPA	<b>Keynote:</b> Disruptive Multifunctional Systems for Demanding Environments
<b>14:20</b>	<b>Coffee</b>	<b>Break</b>

<b>Session Chairs: Victoria Blair (Army Research Lab) &amp; Keith Perkins (Naval Research Lab)</b>		
<b>14:35</b>	<b>Ignacio Perez</b> ONR	Technology Transitions - an ONR Perspective
14:55	<b>Jay Kudva</b> NextGen Aeronautics	<b>Technology Transition Showcase:</b> Transitioning Multifunctional Structures Technologies - Challenges, Opportunities, and Recommendations
15:35	<b>Kathleen Richardson</b> U Central Florida	<b>Technology Transition Showcase:</b> Developing Robust Transition Strategies for Next-Generation Broadband IR Materials
16:15	<b>Jerry Meyer</b> NRL	<b>Technology Transition Showcase:</b> Inter-band Cascade Laser from Theory to Manufacturing
16:55		<b>Wrap-up</b>
<b>17:00</b>	<b>Adjournment</b>	<b>Adjournment</b>

<b>Thursday, December 8</b>		
<b>Time</b>	<b>Speaker</b>	<b>Title of Presentation</b>
<b>08:00</b>		<b>Registration / Housekeeping</b>
<b>Session Chair: Thomas Plaisted (Army Research Lab)</b>		
<b>08:15</b>	<b>Guoliang Huang</b> U Missouri	Control-based Non-Hermitian Active Metamaterials for Odd Elastodynamics
08:40	<b>Walter Lacarbonara</b> U Rome Sapienza <b>Giulia Lanzara</b> U Rome Tre	A High Damping Cellular Material with Integrated Arrays of Nanocomposite Web-like Vibration Absorbers
09:05	<b>Harold Park</b> Boston U	Controlling and Guiding Stress Waves via Quantum Spin Hall-Based Phononic Topological Insulators
09:30	<b>Alexander Idesman</b> Texas Tech U	A New High-Order Accurate Approach for Modeling of Wave Propagation and Heat Transfer in Heterogeneous Materials
<b>09:55</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Keith Perkins (Naval Research Lab)</b>		
<b>10:10</b>	<b>Logan Richardson</b> NRL	Fiber Optic Guided Wave Acoustic Sensing
10:35	<b>Ming Han</b> Michigan State U	Optical Fiber Coil Sensors for Acoustic Emission Detection and Strain Measurement
11:00	<b>Shashank Priya</b> Penn State U	Fiber Acoustics - Control of Acoustic Wave Propagation Through Metallic and Ceramic Fibers
11:25	<b>Kara Peters</b> N. Carolina State U	Investigation of Acoustic Coupling Phenomena in FBG Lamb Wave Detectors
<b>11:50</b>	<b>Lunch</b>	<b>Break</b>

<b>Luncheon Talk - Moderator: Caitlin Williams (Naval Research Lab)</b>		
<b>12:15</b>	<b>Ming Han</b> Michigan State U <b>Kara Peters</b>	<b>Invited Lecture:</b> New Research Directions in Fiber Optic SHM

	N. Carolina State U <b>Shashank Priya</b> Penn State U	
<b>13:05</b>	<b>Coffee</b>	<b>Break</b>

<b>Session Chair: Matthew Laskoski (Naval Research Lab)</b>		
<b>13:20</b>	<b>Mehdi Kiani</b> Penn State U	Towards Distributed Active Ultrasonic Nodes for Structural Health Monitoring
13:45	<b>Yiming Deng</b> Michigan State U	Deep Learning Aided Real-Time Damage Level Assessment and Prediction Based on Fiber Optic Sensing
14:10	<b>Victor Giurgiutiu</b> U So Carolina	Hybrid Physics-based AI-enabled Crack-length Estimation from AE Signal Signatures
14:35	<b>Gary Pickrell</b> VA Tech	Acoustic Generation from a Passive Array
<b>15:00</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Logan Richardson (Naval Research Lab)</b>		
<b>15:15</b>	<b>Wonmo Kang</b> Arizona State U	Innovative Graphene-Metal Composites for Multifunctional Applications
15:40	<b>Haiying Huang</b> U Texas Arlington	Characterizing Sensitization in Heat Treated Aluminum Alloys Using Laser Ultrasound
16:05	<b>Kevin Brenner</b> Southern Methodist U	Acoustic Properties and Applications of Van der Waals Materials
16:30	<b>Sridhar Krishnaswamy</b> Northwestern U	Direct Laser Writing of Sensors for System Health Monitoring
16:55		<i>Wrap-up</i>
<b>17:00</b>	<b>Adjournment</b>	<b>Adjournment</b>

<b>Friday, December 9</b>		
<b>Time</b>	<b>Speaker</b>	<b>Title of Presentation</b>
<b>08:00</b>		<i>Registration / Housekeeping</i>
<b>Session Chair: Todd Henry (Army Research Lab)</b>		
<b>08:15</b>	<b>Greg Reich</b> <b>Philip Beran</b> <b>Alex Pankonien</b> AFRL/RQ	Bio-inspired Reconfigurable System Design via Topology Optimization
08:40	<b>Dan Inman</b> U Michigan	Towards Neural Control for Fly-by-Feel Morphing
09:05	<b>David Lentink</b> U Groningen	Autonomous Morphing of Flexible Wing and Rudderless Air Vehicles with Reflexive And Adaptive Control Capabilities
09:30	<b>Giulia Lanzara</b> U Rome Tre <b>Walter Lacarbonara</b> U Rome Sapienza	Multi-constraint Effect of Magnetic Field-Particles Interaction Towards Advanced Morphing

<b>09:55</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Robert Haynes (Army Aviation &amp; Missile Center)</b>		
<b>10:10</b>	<b>James Joo</b> AFRL/RQ <b>Doug Hunsaker</b> Utah State U <b>Dave Myszka</b> U Dayton	Bio-inspired Flight Using a Rotating Empennage
10:35	<b>Marc Miskin</b> U Penn	Microrobots for Multifunctional Materials
11:00	<b>Ryan Truby</b> Northwestern U	(YIP) Robotic Architected Materials with Distributed Sensorimotor Capabilities via Free-form Electrochemical Composites
11:25	<b>Rob Shepherd</b> Cornell U	Chemical Wiring in Composites for Multifunctional Energy Storage, Data Transmission, and Distributed Computation
<b>11:50</b>	<b>Adjournment</b>	<b>Adjournment</b>

<b>Luncheon Talk - Moderator: James Thomas (Naval Research Lab)</b>		
<b>12:15</b>	<b>Leif Asp</b> Chalmers Univ. of Technology <b>Dan Zenkert</b> KTH Royal Inst. of Technology <b>Emile Greenhalgh</b> Imperial College London	<b>Invited Lecture:</b> (i) Damage Tolerance and Durability of Structural Power Composites; (ii) Mechanical and Impact Properties of Structural Power Devices
<b>13:05</b>	<b>Coffee</b>	<b>Break</b>

<b>Session Chair: Greg Reich (Air Force Research Lab)</b>		
<b>13:20</b>	<b>Ray Baughman</b> U Texas Dallas	Knowledge-Driven Design and Optimization of New Types of Yarn and Fiber Artificial Muscles
13:45	<b>Peter Finkel</b> NRL	Multi-ferroics for Energy Harvesting
14:10	<b>Mike Durstock</b> <b>Phil Buskohl</b> <b>Abby Juhl</b> AFRL/RX	Architecting the Future of Energy Storage – From 2D to 3D
14:35	<b>Fu-Kuo Chang</b> Stanford U	Real-Time Battery Health Monitoring with Built-in Ultrasonic Techniques for Electric Aerial Vehicles
<b>15:00</b>	<b>Coffee</b>	<b>Break</b>
<b>Session Chair: Richard Beblo (Air Force Research Lab)</b>		
<b>15:15</b>	<b>Jerry Qi</b> GA Tech <b>Martin Dunn</b> U Colorado Denver	Hybrid 3D Printing: Pick-and-Place Robotics for Additive Fabrication of 4D Composites;
15:40	<b>Will Boley</b> Boston U	(YIP) 4D Printing Materials with Programmed Responsiveness and Stiffness for Multifunctional Adaptive Architectures

16:05	<b>Jerry Qi</b> GA Tech <b>Martin Dunn</b> <b>Kai Yu</b> U Colorado Denver <b>Kurt Maute</b> U Colorado Boulder	Integrated Multiscale Design and Additive Manufacture of Multifunctional Composites
16:40	<b>Les Lee</b> AFOSR <b>Dan Cole</b> ARO <b>Ignacio Perez</b> ONR	<i>Closing Remarks</i>
<b>17:00</b>	<b>Adjournment</b>	<b>Adjournment</b>

#### MAIN WEBSITE

<https://community.apan.org/wg/afosr/w/researchareas/34690/2022-the-6th-multifunctional-materials-for-defense-workshop/>

Including the information on the meeting registration, agenda, hotels and parking

#### Optional Virtual Attendance Link:

All registered attendees will have an option to indicate “attendance preference” for “in person” or “virtual.”

The ZoomGov details will be emailed to all registered guest on December 2, 2022.

Those who have registered before “attendance preference” was available will be contacted by:

RAGSDALE, KATHY M CIV USAF AFMC AFOSR/ITA <kathy.ragsdale.1@us.af.mil>.

#### MEETING SITE

#### **Basic Research Innovation & Collaboration Center (BRICC)**

4100 North Fairfax Drive, Suite 450  
Arlington, VA 22203

Please note that the building's elevators are operational at 8:00 AM.  
Guest arriving earlier than 8:00 AM should kindly wait in the building lobby.