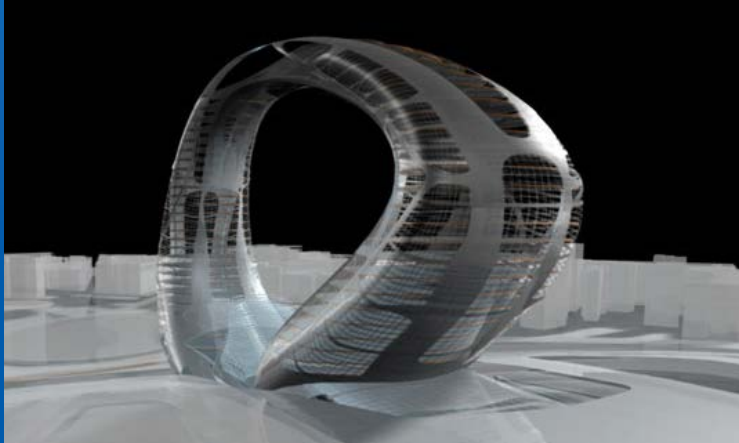
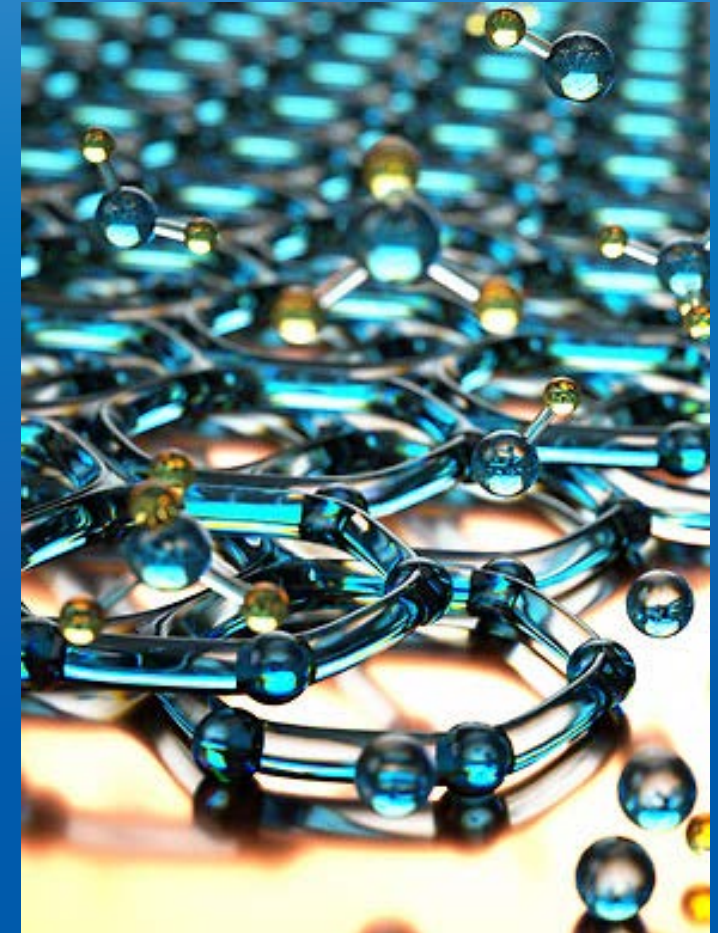
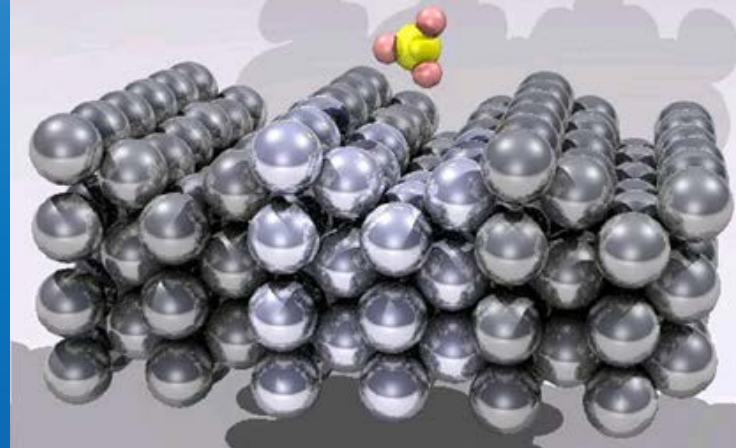
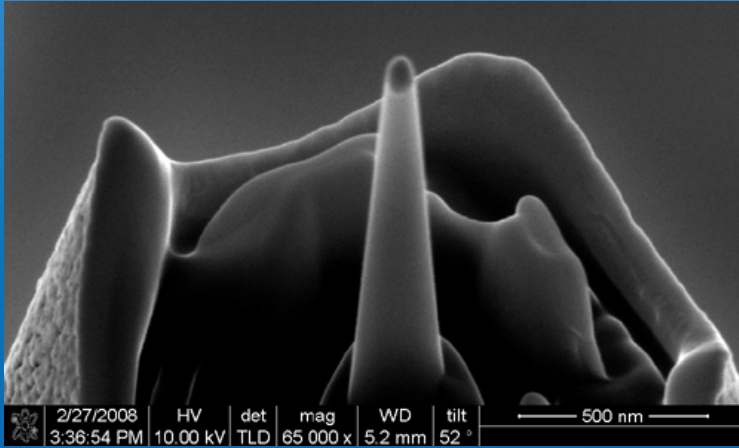


# Welcome to MSE @ UCLA

**UCLA** | **Samueli**  
School of Engineering

**Engineer Change.**



**Bruce Dunn, Ph.D.**

Professor and Chair, Materials Science and Engineering

# Discover UCLA Engineering - Materials Science and Engineering



**Bruce Dunn**  
*Professor and Chair*



**Ioanna Kakoulli**  
*Professor*



**Jaime Marian**  
*Professor*



**Suneel Kodambaka**  
*Professor*



**Ya-Hong Xie**  
*Professor and Vice-Chair*



**Catherine Barrie**  
*Current Student*



**Megan Bokhoor**  
*Current Student*



**Garret May**  
*Current Student*



**Rayna Mehta**  
*Current Student*



**Meredith Sanderson**  
*Current Student*



**Claire Shen**  
*Current Student*



**Seth Siegel**  
*Current Student*



**Thomas Tran**  
*Current Student*



**Annie Zhao**  
*Current Student*



**Jan LaBuda**  
*Director, Academic and Student Affairs*



**James Washington**  
*Academic Counselor*



**James Barrie**  
*Alumni*



**Tiffany Tsao**  
*Alumni*



**Makena White**  
*Alumni*

**10-10:30am - Faculty**

**10:30-11am - Current Students**

**11-11:30am - Alumni**

**11:30am-12pm - Breakout Sessions**

**Questions:**

**Use the Q & A function at any time**

**or**

**At the end of the presentation, use the Raise Hand function**



- MSE Program Objectives
  - Behavior, synthesis and application of materials
  - Interdisciplinary integration of science and engineering
  - Materials Engineering and Electronic Materials options
- Highly ranked with thriving undergraduate program
  - Low student–faculty ratio with active student groups
  - Undergraduate research opportunities
  - New building and laboratories for undergraduate education





# So what does a Materials Engineer do?

Process materials

Improve properties of materials

Determine and tailor the structure of materials

Materials Science helps:

- **Create new materials**
- **Optimize the production of materials**
- **Understand how and why materials fail/succeed**
- **Improve sustainability**

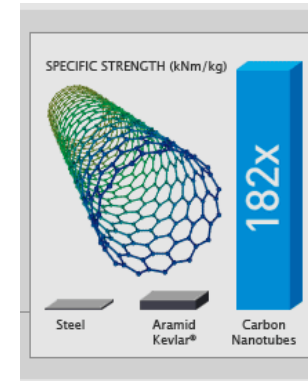
The field of materials is broad and rich:

**Metals, Ceramics, Polymers, Semiconductors, Composites,  
Biomaterials, Nanomaterials...**

## Advanced Materials

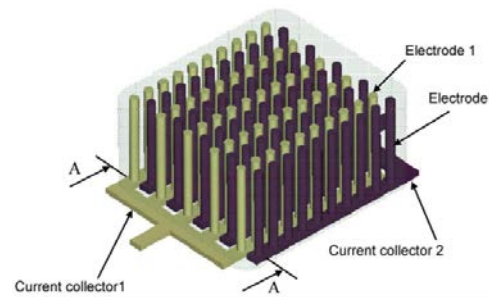


## Aerospace, Biomedical, Sports



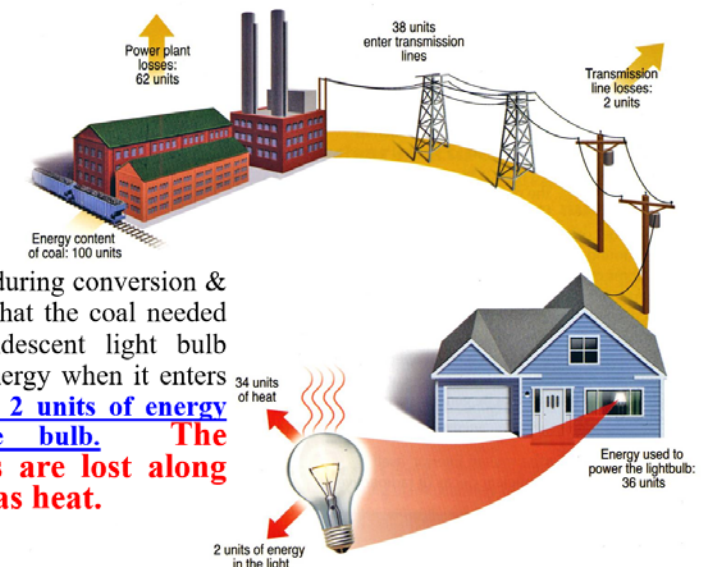
## Energy Related Materials

- LEDs
- Photovoltaics
- Batteries, Supercapacitors

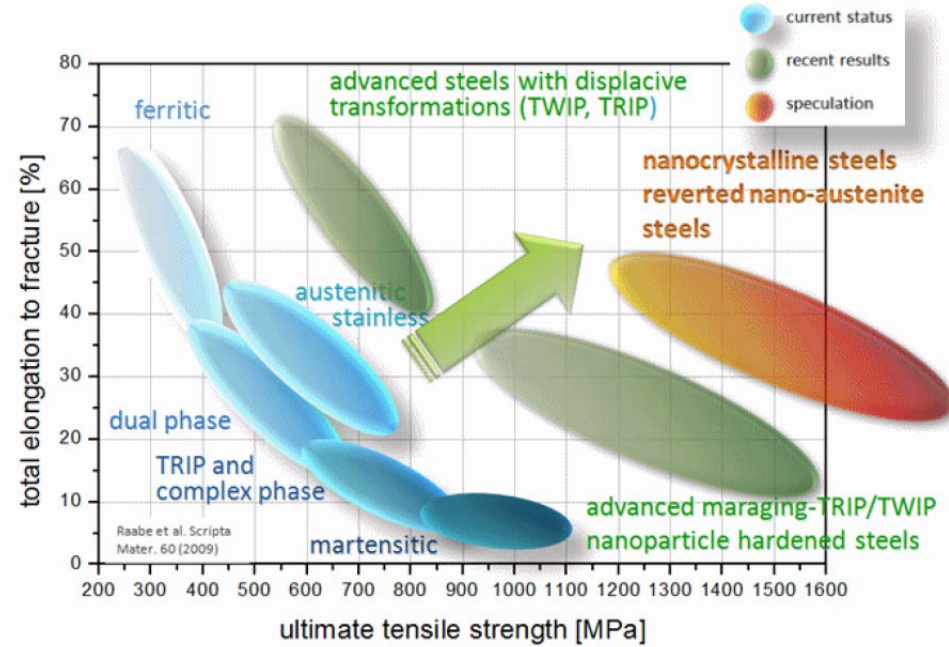


**Overall Efficiency of an Incandescent Bulb  $\cong$  2%**

Example of energy lost during conversion & transmission. Imagine that the coal needed to illuminate an incandescent light bulb contains 100 units of energy when it enters the power plant. Only 2 units of energy eventually light the bulb. The remaining 98 units are lost along the way, primarily as heat.



## Ultra High Strength Metals

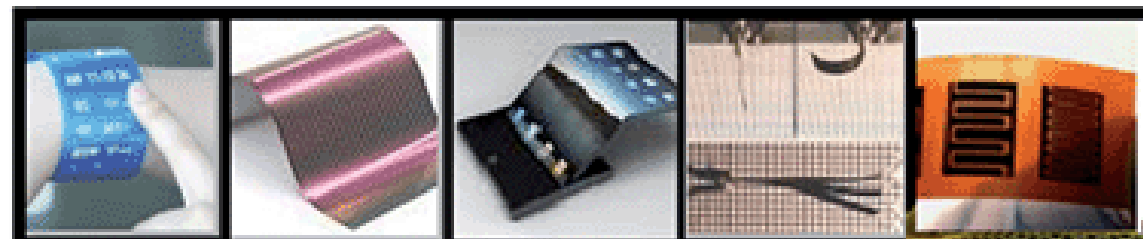
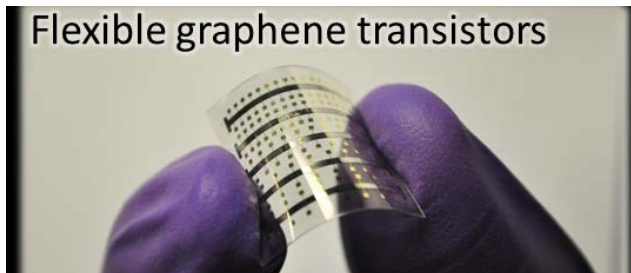


## Smart Clothes



## Flexible Electronics

Flexible graphene transistors





- Undergraduate Students: 125; ~30/year
- Class size: 15 to 35 students
- Faculty advisor: meet once each quarter
- Graduate Students: 225
- Research Funding: ~\$10 M/yr
- Research Opportunities for Undergraduates
  - 199 courses
  - Summer and Industry Internships
- MSE Scholarships
  - Eric Pascal Bescher Scholarship; Lee Family Scholarship
  - Harley L. Wood Scholarship; Knapp Scholarship;
  - Goldsworthy Scholarship; Knesel Scholarship; Boeing;
  - Boeing Scholarship; Mackenzie Scholarship; Ching Chiao Tu Scholarship
- Active student professional society groups

**Faculty = 15 and growing**

Chair →

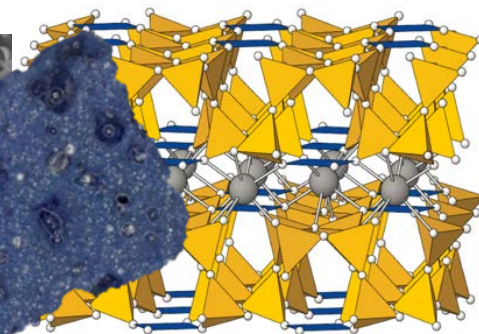
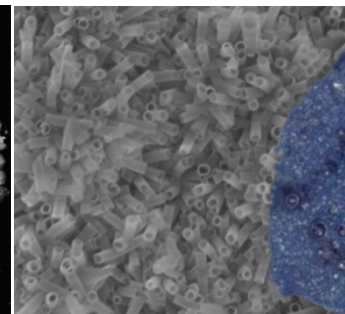
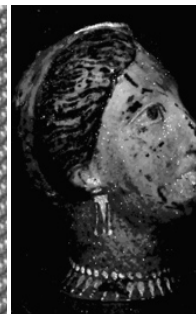
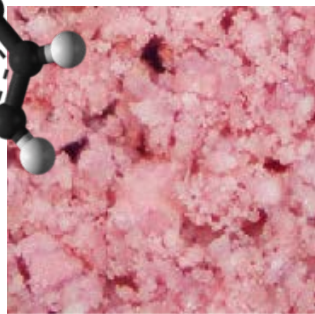
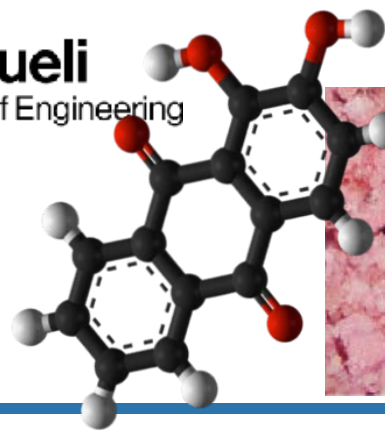
V. Chair →

V. Chair →

First	LAST NAME	e-mail address	Research focus
Ali	<b>MOSLEH</b>	<a href="mailto:mosleh@ucla.edu">mosleh@ucla.edu</a>	Reliability; Risk analysis
Amartya	<b>Banerjee</b>	<a href="mailto:asbanerjee@g.ucla.edu">asbanerjee@g.ucla.edu</a>	Computational materials science
<b>Bruce</b>	<b>DUNN</b>	<a href="mailto:bdunn@ucla.edu">bdunn@ucla.edu</a>	<b>Energy storage</b>
Dwight	<b>STREIT</b>	<a href="mailto:streit@ucla.edu">streit@ucla.edu</a>	Power electronics
<b>Ioanna</b>	<b>KAKOULLI</b>	<a href="mailto:kakoulli@ucla.edu">kakoulli@ucla.edu</a>	<b>Forensic archaeology</b>
<b>Jaime</b>	<b>MARIAN</b>	<a href="mailto:jmarian@ucla.edu">jmarian@ucla.edu</a>	<b>Computational mechanics of materials</b>
Jenn-Ming	<b>YANG</b>	<a href="mailto:jyang@seas.ucla.edu">jyang@seas.ucla.edu</a>	Composites; structural materials
Mark	<b>GOORSKY</b>	<a href="mailto:goorsky@seas.ucla.edu">goorsky@seas.ucla.edu</a>	Photovoltaics
<b>Yu</b>	<b>HUANG</b>	<a href="mailto:yhuang@seas.ucla.edu">yhuang@seas.ucla.edu</a>	Heterogenous catalysis; Nanoelectronics
Qibing	<b>PEI</b>	<a href="mailto:qpei@seas.ucla.edu">qpei@seas.ucla.edu</a>	Variable stiffness materials
Aaswath	<b>Raman</b>	<a href="mailto:aaswath@ucla.edu">aaswath@ucla.edu</a>	Metamaterials, nanophotonics
<b>Suneel</b>	<b>KODAMBAKA</b>	<a href="mailto:kodambaka@ucla.edu">kodambaka@ucla.edu</a>	<b>2D layered materials; Ultra-tough ceramics</b>
Ximin	<b>HE</b>	<a href="mailto:ximinhe@ucla.edu">ximinhe@ucla.edu</a>	Bio-inspired materials
<b>Ya-Hong</b>	<b>XIE</b>	<a href="mailto:yahong.xie@gmail.com">yahong.xie@gmail.com</a>	<b>Nanoelectronics; Biosensors</b>
Yang	<b>YANG</b>	<a href="mailto:yangy@ucla.edu">yangy@ucla.edu</a>	Organic & inorganic Photovoltaics



**Samueli**  
School of Engineering



# Archaeomaterials Research Group & Molecular and Nano Archaeology Laboratory

<https://archaeomaterialsgroup.wordpress.com/>

**Dr. Ioanna KAKOULLI**

Professor, UCLA Department of Materials Science  
and Engineering

Professor, UCLA Conservation IDP (joint  
appointment)

Adjunct Professor, University of Cyprus

## EDUCATION

**DPhil (Ph.D.), University of Oxford, UK**

*Materials Science (archaeological materials  
science)*

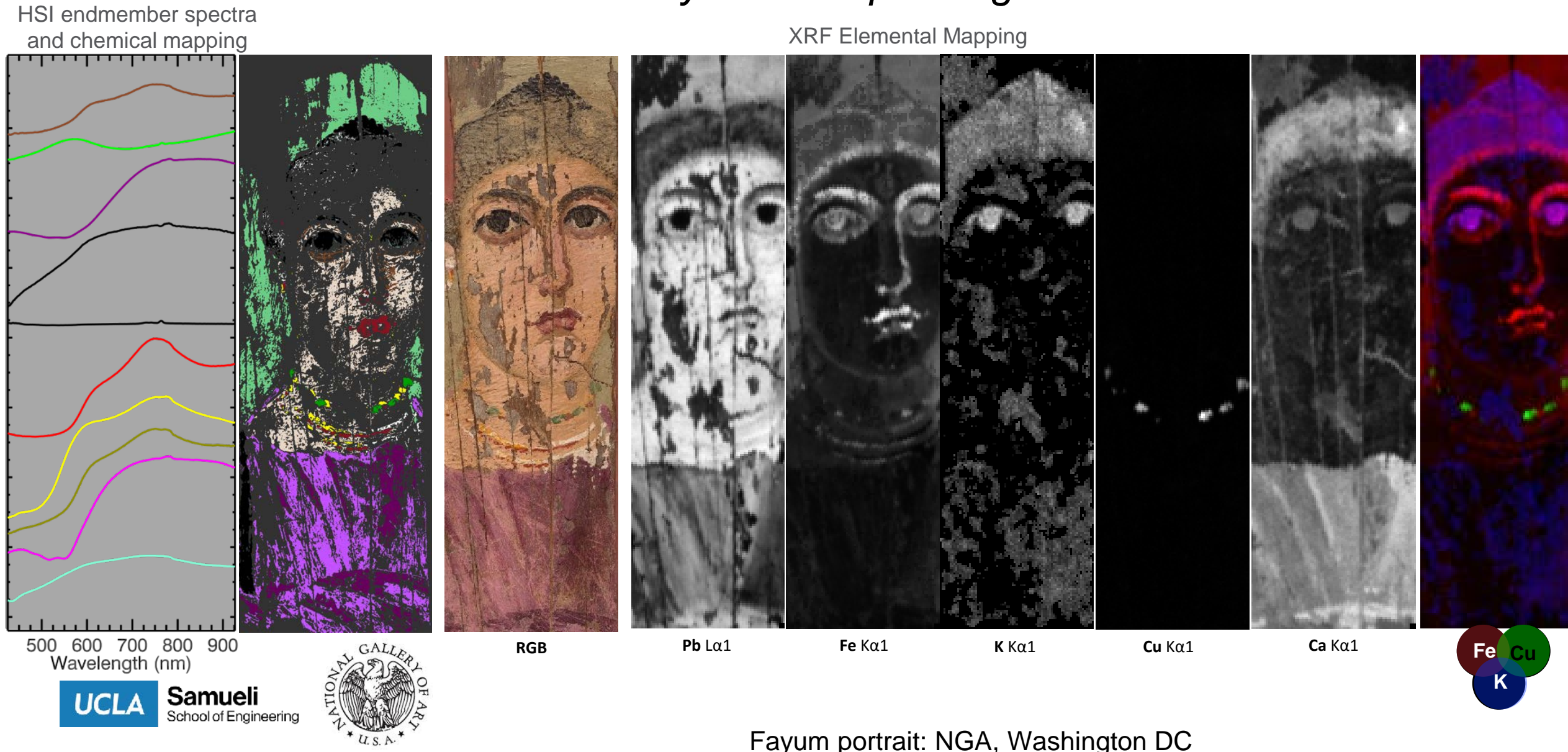
**M.Sc. University of London**

*Materials Chemistry and Conservation*



# Characterization of materials: Macroscale multimodal imaging spectroscopy

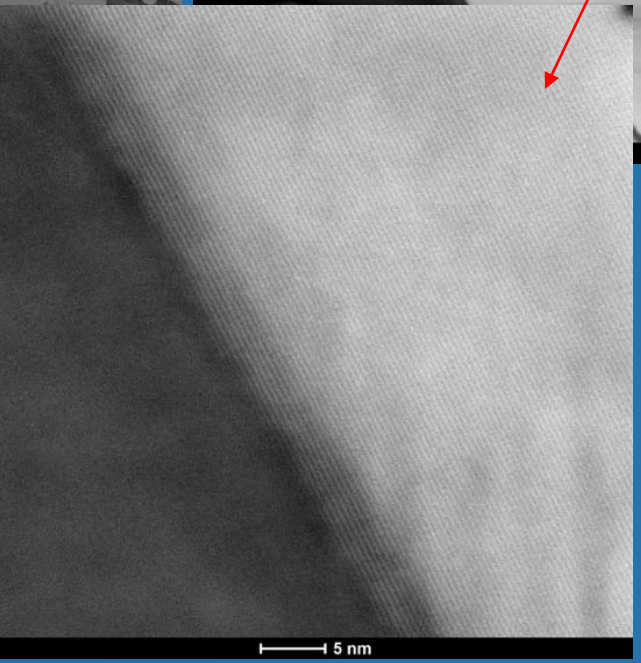
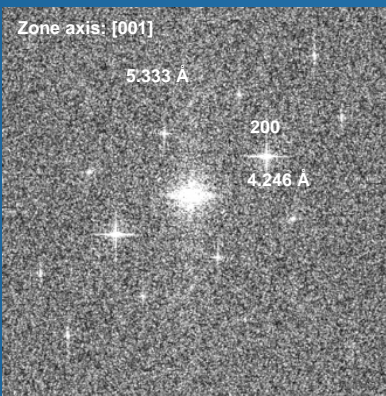
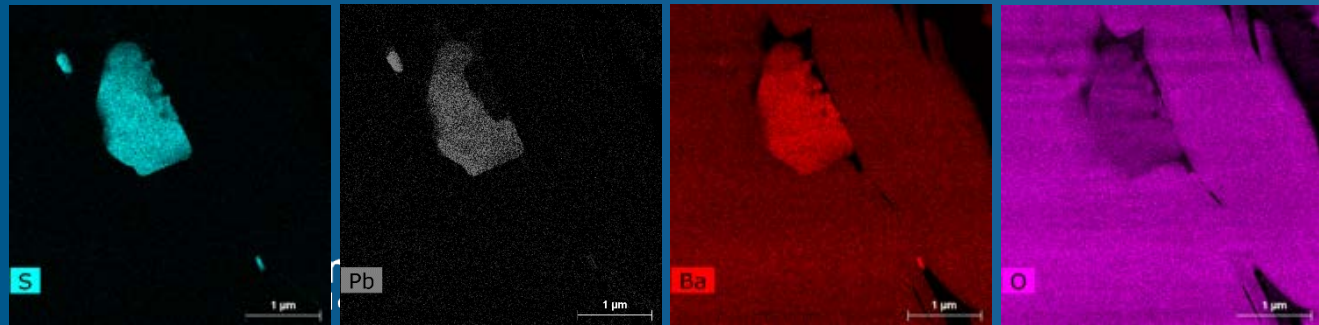
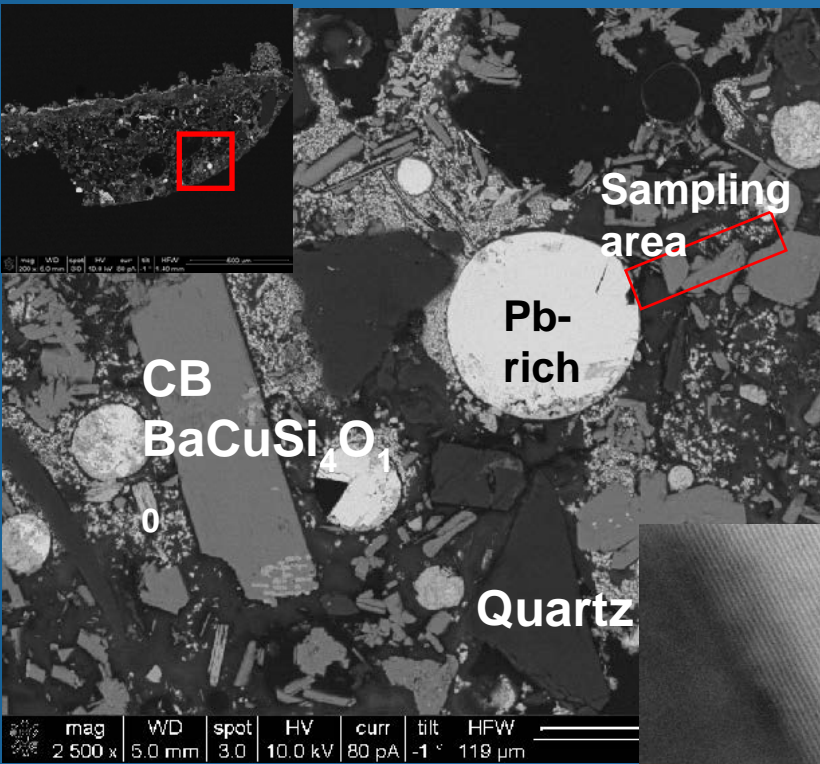
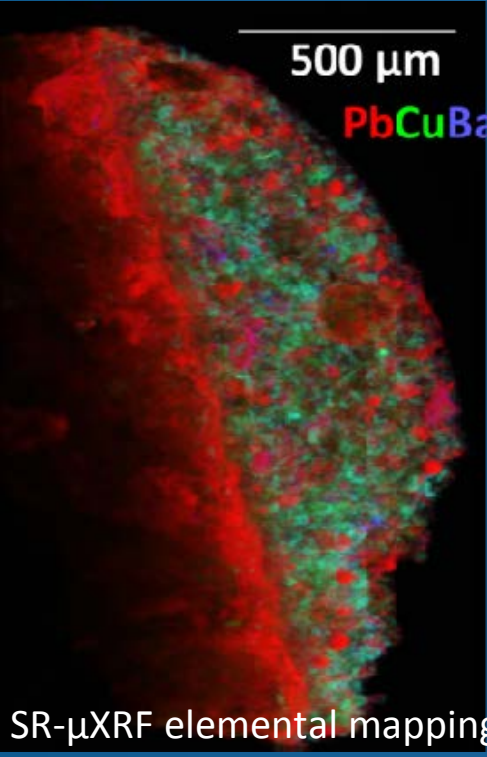
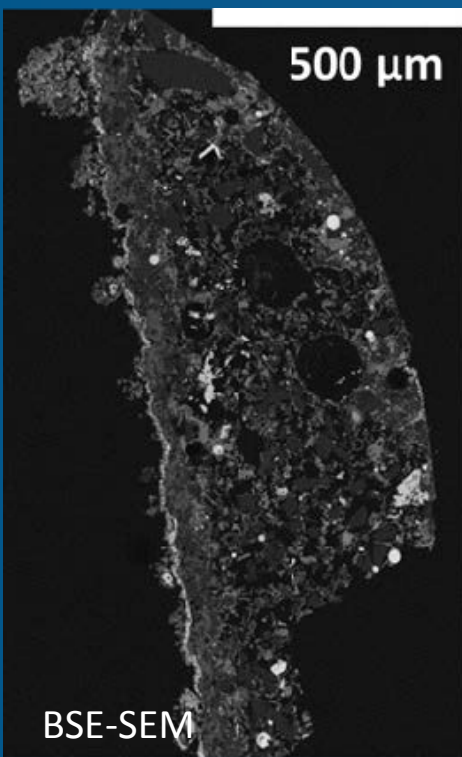
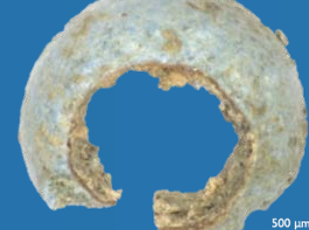
## *1800 year's old painting*





# Characterization of Materials: Micron and sub-micron scale

## *Ancient Chinese ceramic bead using SEM, SR-uXRF, and STEM*





# Research

# 5 Scientific Pursuits

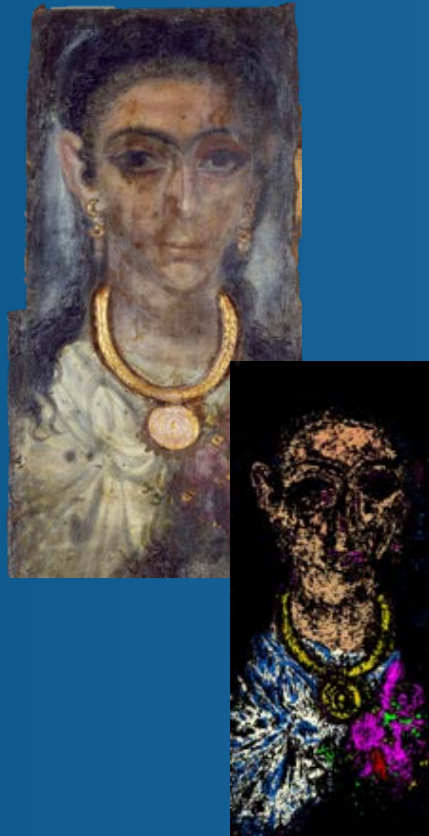
**Archaeological Forensics**  
*Identification of diagnostic markers for authentication and provenance*



Special Agent, DHS

**UCLA Samueli**  
School of Engineering

**Ancient Technology**  
*Reverse engineering  
Production technology*



Graeco-Roman portrait,  
The Walters Art Museum

**Human Agency & the Environment**



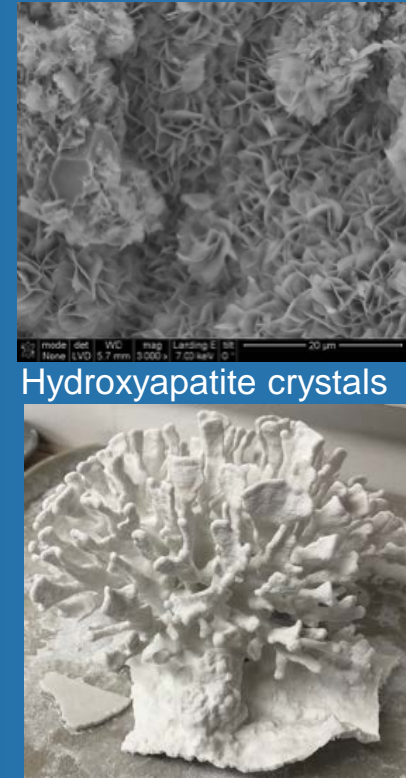
Mummified Human remains,  
Chile

**Archaeo-inspired materials**  
*Design of novel materials inspired by ancient technology*



Chinese Blue  
NIR luminescent nanoscrolls

**Conservation Science & Biocultural Conservation**  
*Synthesis of materials and applications to preserve cultural and natural heritage*



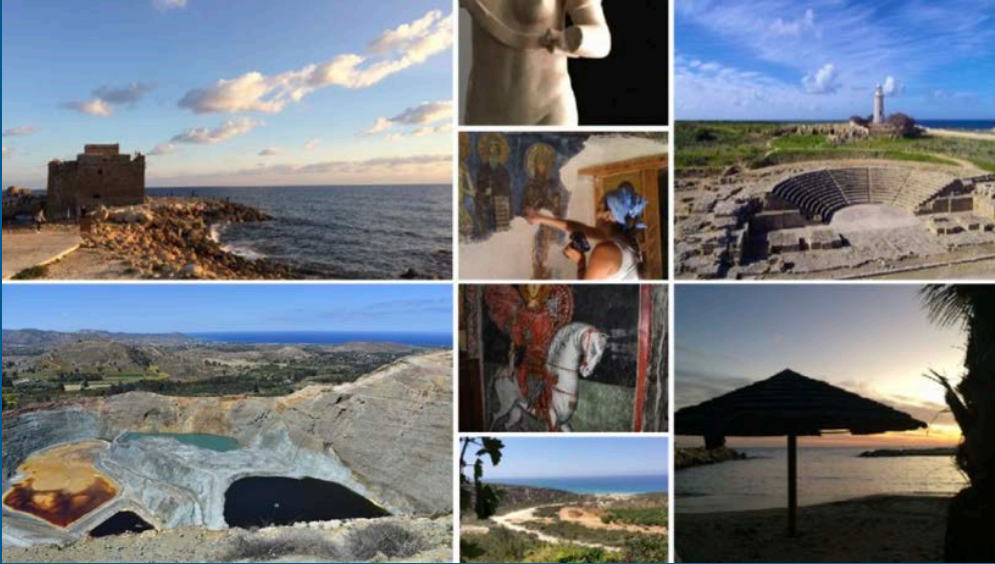
Hydroxyapatite crystals

Model of 3D printed artificial coral for marine rehabilitation



# Teaching

*Study Abroad Program) for 10-12 Units on “Ancient Technology, Materials and Forensics*



- MAT SCI 33 - Materials Structure and Technology in Archaeology and Architecture (MST-A<sup>2</sup>)
- MAT SCI 13L - Cultural [Materials] Science Investigations in Art and Archaeology (CSI-A<sup>2</sup>)

# Knowledge Transfer & Outreach

- Transforming STEM (Science, Technology Engineering and Mathematics) into STEAM adding (Arts).
- Developing scientists for a global society with strong scientific skills integrated with social and humanistic methodologies.
- Promotes diversity in STEM fields.
- Community outreach through museums, science fairs and specialized workshops and presentations with hands-on activities.

# Materials design and discovery by theory, modeling, and simulation

Prof. Jaime Marian

*Department of Materials Science and Engineering  
Department of Aerospace and Mechanical Engineering*

**UCLA**

[jmarian@ucla.edu](mailto:jmarian@ucla.edu)

Ph: 310-206-9161

<http://jmarian.bol.ucla.edu>



# We try to design, develop, and run computational models to understand materials behavior

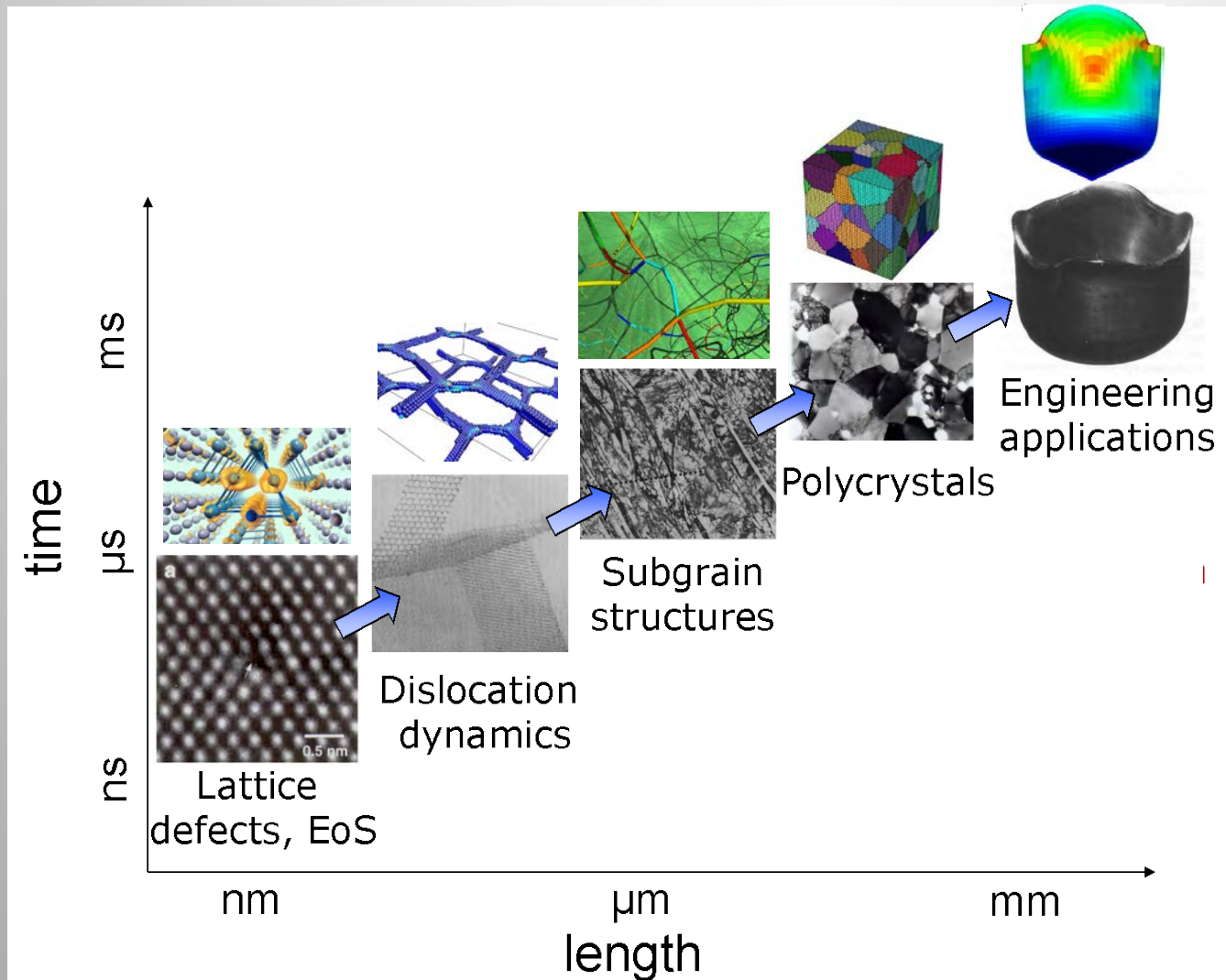
- In modern science there are many examples of conditions that cannot be accessed experimentally (conditions inside stars, earth's inner mantle and core, nuclear processes, structure of microorganisms, etc.)
- Our aim is to use materials theory and simulation to open windows into these processes.
- Our models must be continuously validated, benchmarked, and contrasted to experimental data.
- The future of science cannot be understood with modeling and simulation



# Teaching: Mechanical Behavior of Materials/Computational Modeling

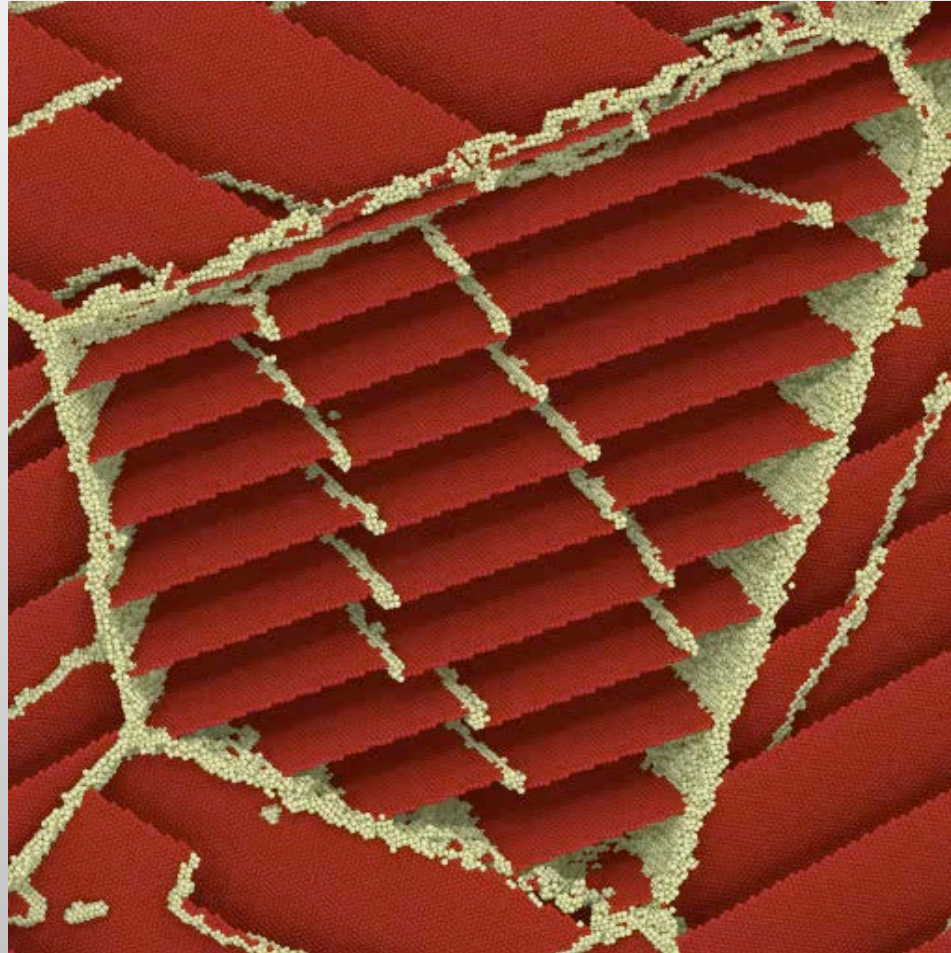
- Instructor in charge of the mechanical behavior curriculum with MSE:
  - Two undergraduate courses
    - MS143A: Mechanical Behavior of Materials
    - MS132: Structure and Properties of Metallic Alloys
  - Two graduate courses:
    - MS243C: Dislocations and Strengthening Mechanisms in Solids
    - MS270: Computational Modeling of Materials

# Multiscale modeling: joining time and space scales



- We develop computational models to understand materials behavior under extreme conditions.
- We use a *multiscale* approach, different techniques at different time and length scales.

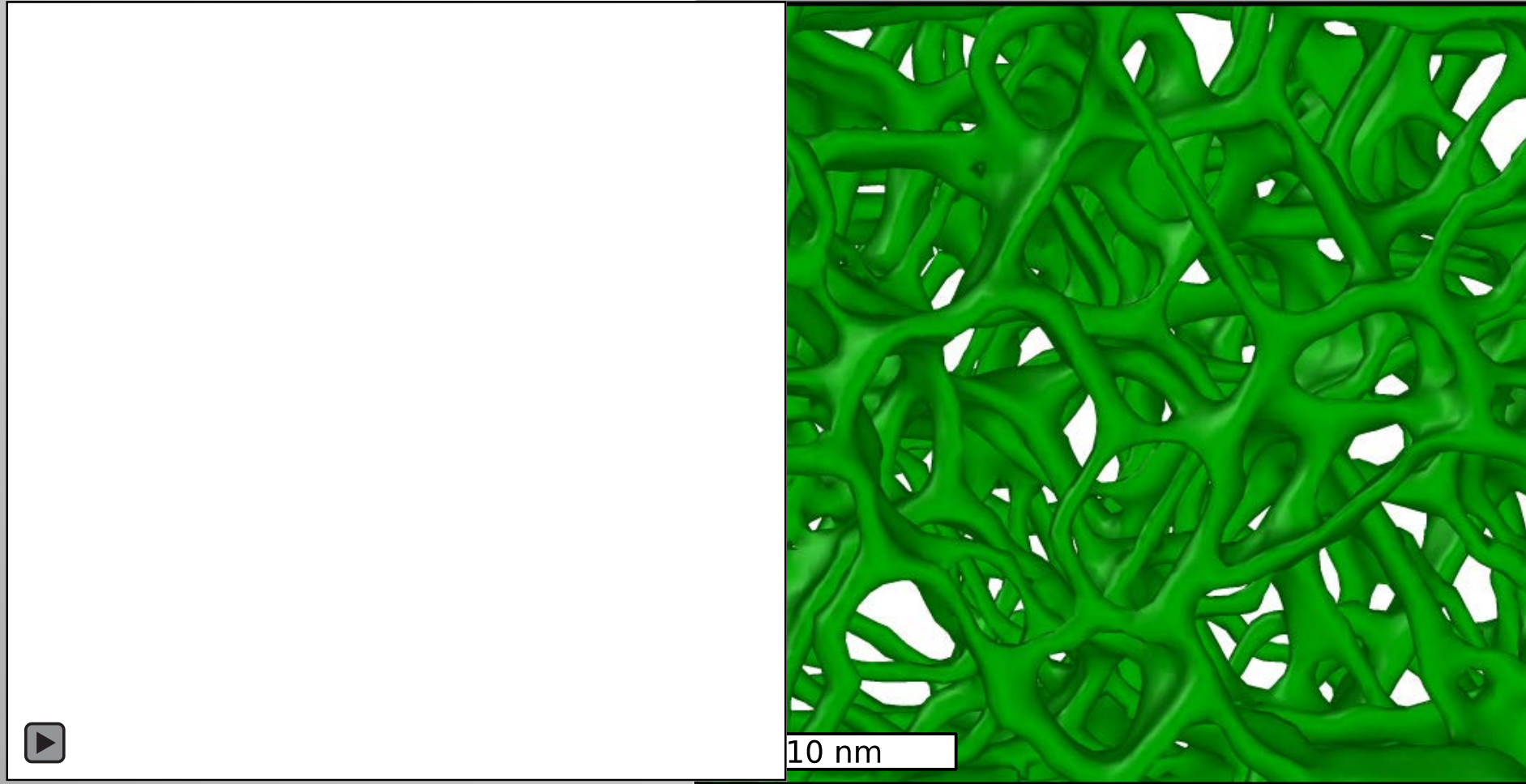
# Too small: Deformation mechanisms in nanotwinned Cu alloys



- We study what controls the strength of nanotwinned metals



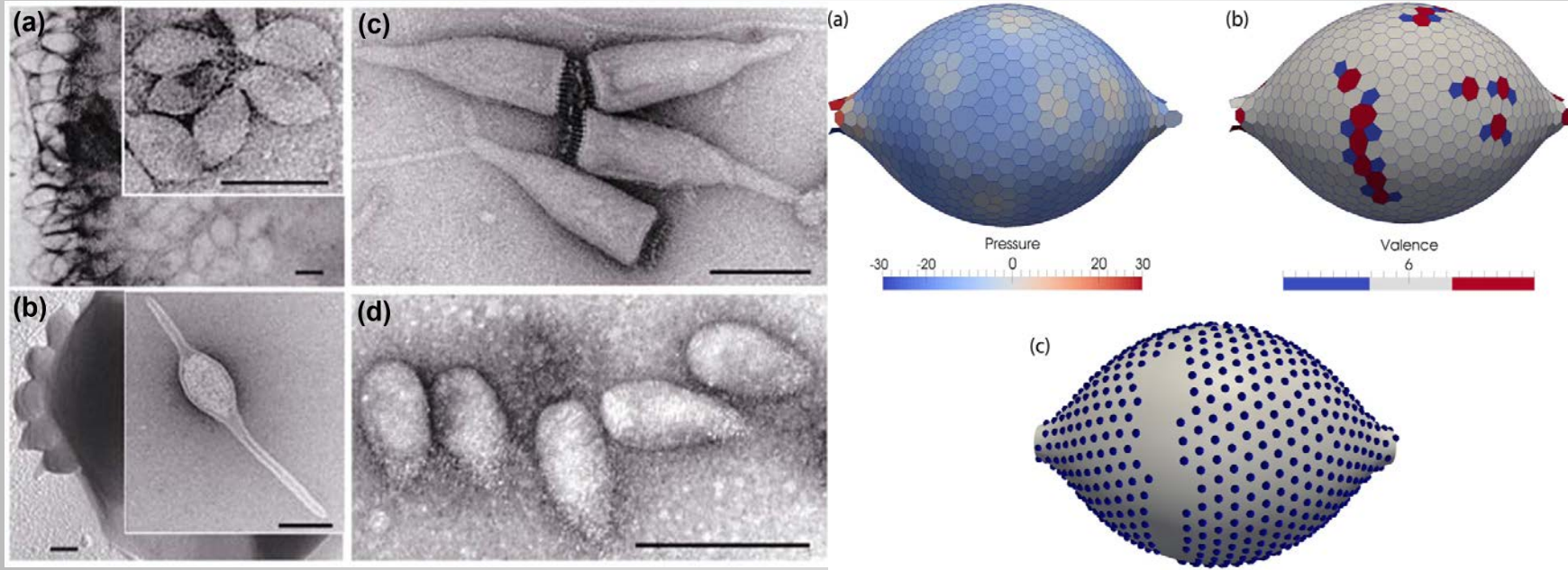
# Nanotwin networks in [111] direction:



Sandoval, Reina, Marian, Scientific Reports (2015)



# Biomedical: models of capsid structure and properties of archeal viruses



- *Archaea* survive in extreme environments of high temperatures, salinity, or acidity.
- They are infected by archaeal viruses: exotic variety of single and double stranded DNA viruses
- The properties of the capsid determine the amount of DNA packed in the viruses, their motility, and their vulnerabilities

**Suneel Kodambaka**

Professor

Materials Science and Engineering

Email: [kodambaka@ucla.edu](mailto:kodambaka@ucla.edu)

# My Background

- ❖ Joined UCLA in 2007
- ❖ B.Tech., in Metallurgical Engineering  
Indian Institute of Technology, Madras, India
- ❖ M.S. – Southern Illinois University at Carbondale, IL
- ❖ Ph.D. – Univ. Illinois Urbana-Champaign, IL
- ❖ Post-doctoral research:  
IBM T.J. Watson Research Center, Yorktown Heights, NY

# Research Interests

- ❖ *In situ* characterization of materials synthesis
- ❖ Thin films
- ❖ 2D layered materials
- ❖ Nanomechanics of ceramic materials



# Teaching & Service

- ❖ Freshman Seminar
- ❖ Introductory laboratory on measurements
- ❖ Principles of Nanoscience and Nanotechnology
  
- ❖ MSE representative for
  - ❖ Diversity
  - ❖ Undergraduate Council
  - ❖ ABET (2013-18)
- ❖ Undergraduate Vice Chair (2013-18)

**Ya-Hong Xie**

Professor & Vice Chair for Undergraduate Studies

Department of Materials Sciences & Engineering

University of California Los Angeles

(310) 825-2971

[yhx@seas.ucla.edu](mailto:yhx@seas.ucla.edu)

# Background

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## Education:

- BS in Physics (Purdue University, 1981);
- MS & PhD in Electrical Engineering (UCLA, 1983, 1986);

## Professional Career:

- Bell Laboratories (1986-1999);
- UCLA (1999 – present);

## Research fields:

- Biosensing with surface enhanced Raman spectroscopy combined with machine learning;
- Semiconductor materials, optoelectronic processes and crystal growths;
- Semiconductor device physics;
- Integrated circuit technologies;



# Teaching

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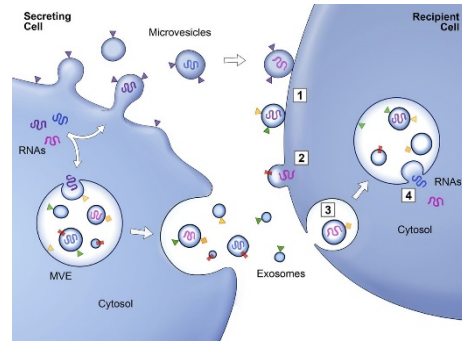
## Undergraduate:

- MS120: Physics of Materials;
- MS121: Materials Science of Semiconductors;
- MS130: Phase Relations in Solids;

## Graduate:

- MS200: Principles of Materials Science I;
- MS201: Principles of Materials Science II;
- MS224: Deposition Technologies and Their Applications;
- MS226: Si-CMOS Technology: Selected Topics in Materials Science.

# Research



## Surface enhanced Raman spectroscopy

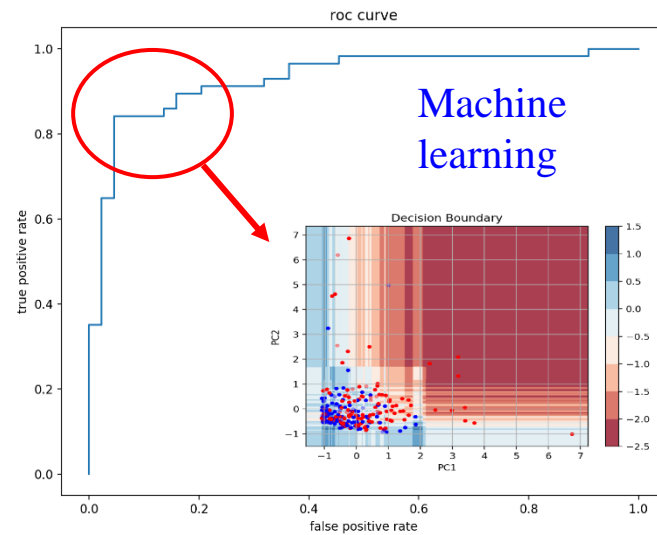
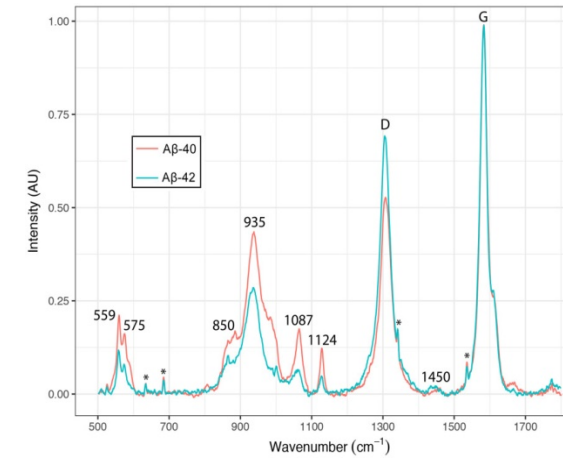
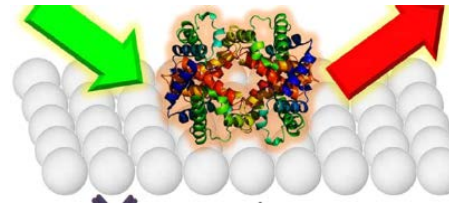
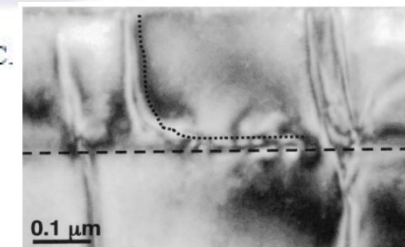


Fig. 3: 150mm PCT rated at 8.5kV/4000A for UHVDC.



## Power switching technologies



**Any questions for  
our faculty?**





# MSE Student Life At UCLA

# Who We Are



- ❑ Being an MSE student gives you an immediate community and identity on campus
- ❑ We are leaders in technical projects and organizations on campus
- ❑ We are a collaborative, diverse group of students looking to learn from our classes and each other
- ❑ We are a family!



# Career Opportunities

Career Fair and Info Sessions with companies like PPG, HRL, General Atomics, Boeing and more!





# Research

- ❑ Research opportunities for undergraduates in faculty labs
- ❑ MRS hosts lab tours for those looking to do on campus research
- ❑ Get to know graduate students





# MRS Socials

- ❑ Opportunities to explore LA and campus with matsci friends!





# Meeting Your Best Friends!

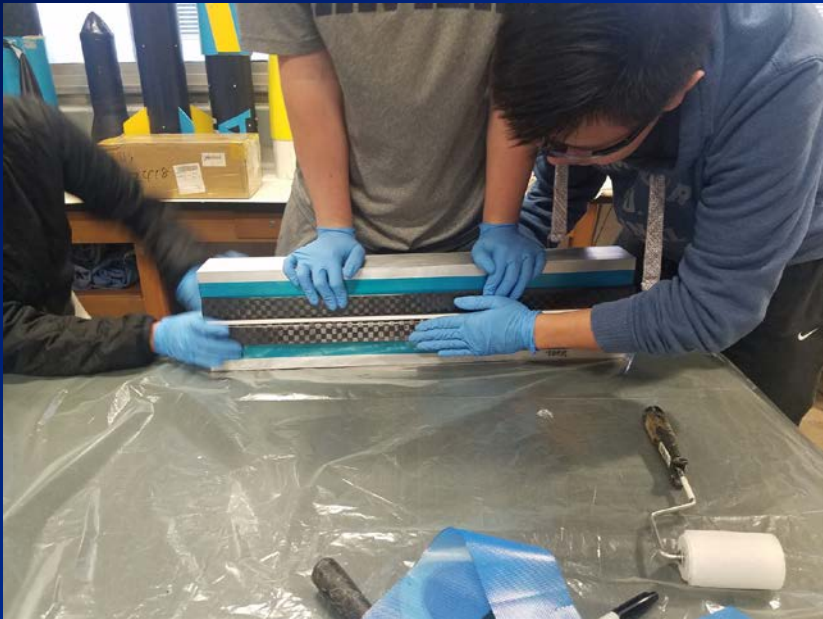
- ❑ MSE is a community that supports you in and out of the classroom!





# SAMPE Beam Competition

- ❑ Hands-on composites experience (carbon, glass, natural fibers)!
- ❑ Goal: Construct the lightest beam to surpass a design load





# Conference

- ❑ Opportunity to travel and network with students and industry members from around the world!





# Thank you

Any questions?

# Materials Science and Engineering Alumni



**James Barrie**

- ❑ B.S. in Engineering (1983)
- ❑ M.S. in Materials Science and Engineering (1985)
- ❑ Ph.D. in Materials Science and Engineering (1988)
- ❑ The Aerospace Corporation
- ❑ Department Lecturer
- ❑ Donor



**Tiffany Tsao**

- ❑ Class of 2010, B.S.
- ❑ Consumer Electronics
- ❑ Former Employers
  - Cisco Meraki
  - Amazon Lab126
  - Netgear



**Makena White**

- ❑ B.S. '16 Materials Engineering
- ❑ M.S. '21 Materials Science and Engineering
- ❑ Northrop Grumman Materials and Process Engineer

**Any questions for  
our alumni?**

# Thank You!

## Please join us at the Breakout Session to chat more!

Discover MSE Academics - <https://ucla.zoom.us/j/166966943> - Zoom Meeting ID 166-966-943

Discover MSE Career Paths - <https://ucla.zoom.us/j/434146954> - Zoom Meeting ID 434-146-954

Discover MSE Internships - <https://ucla.zoom.us/j/813797999> - Zoom Meeting ID 813-797-999

Discover MSE Research - <https://ucla.zoom.us/j/335304766> - Zoom Meeting ID 335-304-766

Discover MSE Student Life - <https://ucla.zoom.us/j/403525110> - Zoom Meeting ID 403-525-110

Discover UCLA Engineering Virtual Agenda - <https://www.seasoasa.ucla.edu/discover/>