

# 2D MXenes

## 10 YEARS LATER

MXene Conference 2020

August 3<sup>rd</sup> - 7<sup>th</sup>, 2020

Drexel University, Philadelphia, PA, USA

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Preceded by MXene Synthesis and Characterization Courses  
on July 27<sup>th</sup> - 31<sup>st</sup>, 2020.



# Program



## Chair

### Michel W. Barsoum

Distinguished Professor  
Materials Science and Engineering Department  
Drexel University  
Email: barsoumw@drexel.edu  
Phone: 215-895-2338



## Co-Chair

### Yury Gogotsi

Distinguished University and Charles T. and Ruth M. Bach Professor  
Director, A.J. Drexel Nanomaterials Institute  
Materials Science and Engineering Department  
Drexel University  
Email: gogotsi@drexel.edu  
Phone: 215-895-6446



## Event Manager

### Danielle Kopicko

Associate Director  
A.J. Drexel Nanomaterials Institute  
Drexel University  
Email: dt372@drexel.edu  
Phone: 215-895-1768

Monday, August 3<sup>rd</sup>, 2020 | 8:00 AM - 11:30 AM (EST)

## Topic: Synthesis, Structure, and Properties

**Session Chair:** Michel W. Barsoum, Drexel University, USA

**8:00 AM EST – 9:30 AM EST**

### Opening Remarks:

M. W. Barsoum, S. Walker, A. Saunders, Drexel University, USA

### Plenary Speaker:

Johanna Rosén, Linköping University, Sweden

*Title: “Expanding the structural and elemental space of MAX phases and MXenes”*

**9:30 AM EST – 11:30 AM EST**

### Keynote Speakers:

Mohammad Khazaei, NIMS, Japan

*Title: “Charge injection effects on exfoliation possibility of MAX phases and actuation properties of 2D MXenes”*

Qing Huang, NIMTE, CAS, China

*Title: “Exploration of novel MAX phases and their derived MXene via A-site replacement reaction in molten salts”*

Garritt Tucker, Colorado School of Mines, USA

*Title: “Probing the atomic-scale origins of strength and deformation of MXene materials: on new atomistic modeling methods and approaches”*



# Program

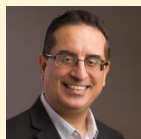
**Tuesday, August 4<sup>th</sup>, 2020 | 8:30 AM - 11:30 AM (EST)**

**Topic: Electronic and Medical Applications**

**Session Chair:** Michael Naguib, Tulane University, USA

**8:30 AM EST – 9:30 AM EST**

**Plenary Speaker:**

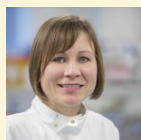


Husam Alshareef, KAUST, Saudi Arabia

*Title: “MXetronics: MXenes for electronic and sensing applications”*

**9:30 AM EST – 11:30 AM EST**

**Keynote Speakers:**



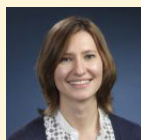
Susan Sandeman, Brighton, UK

*Title: “MXenes and the inflammatory response to life threatening infection”*



Thierry Ouisse, LMGP, INP-Grenoble, France

*Title: “MAX to MXenes: why are single crystals useful”*



Lyubov Titova, WPI, USA

*Title: “Time-resolved terahertz spectroscopy of MXenes: microscopic conductivity and photoexcited carrier dynamics”*

**Wednesday, August 5<sup>th</sup>, 2020 | 8:30 AM - 13:00 PM (EST)**

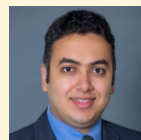
**Topic: Chemistry-Processing-Properties Relationships**

**Session Chair:** Steven May, Drexel University, USA



**8:00 AM EST – 9:30 AM EST**

**Plenary Speaker:**

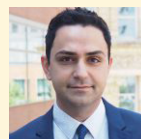


Michael Naguib, Tulane University, USA

*Title: “Role of intercalation in MXenes processing and performance”*

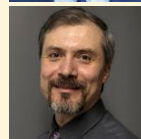
**9:30 AM EST – 11:30 AM EST**

**Keynote Speakers:**



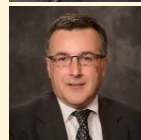
Babak Anasori, IUPUI, USA

*Title: “Double transition metal MXenes, tuning MXenes properties from inside”*



Vadym Mochalin, Missouri S&T, USA

*Title: “Insights into MXene chemistry and its use for application development”*



Miladin Radovic, Texas A&M, USA

*Title: “Improving yield of MXene synthesis and their oxidation resistance”*



**11:30 AM EST – 12:00 PM EST: Featured Talk**

Lynnette D. Madsen, NSF, USA

*Title: “Nurturing new research discoveries and fostering development and commercialization”*

**12:00 PM EST – 13:00 PM EST**

**Commercialization and Investment Panel**

**Moderator:** Shintaro Kaido, Drexel University, USA

Representatives from NSF, Heritage Group Ventures,  
Osage University Partners, Prime Movers Lab



# Program

Thursday, August 6<sup>th</sup>, 2020 | 8:30 AM - 11:30 AM (EST)

**Topic: Energy Related Applications, from Modeling to Implementation**

**Session Chair:** Ekaterina Pomerantseva,  
Drexel University, USA

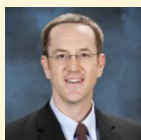


8:30 AM EST – 9:30 AM EST

**Plenary Speaker:**

Paul Kent, Oak Ridge National Lab, USA

*Title: "Tracking ion intercalation into layered  $Ti_3C_2$  MXene films across length scales"*



9:30 AM EST – 11:30 AM EST

**Keynote Speakers:**

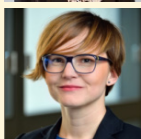
Pooi See Lee, Nanyang Tech. University, Singapore

*Title: "Highly responsive MXene soft actuator"*



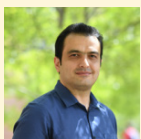
Aleksandra Vojvodic, University Penn, USA

*Title: "Chemistry and electrocatalysis of nano-structured carbides, nitrides and oxides"*



Majid Beidaghi, Auburn University, USA

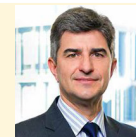
*Title: "Assembling multilayered and heterolayered MXene electrodes for energy storage"*



Friday, August 7<sup>th</sup>, 2020 | 8:00 AM - 11:30 AM (EST)

**Topic: Applications of MXenes**

**Session Chair:** Yury Gogotsi, Drexel University, USA



8:00 AM EST – 9:30 AM EST

**Keynote Speakers**

Guoxiu Wang, UTS, Australia

*Title: "The applications of MXenes for energy conversion and storage"*



Chong Min Koo, KIST, Korea

*Title: "Anomalous absorption of electromagnetic waves by 2D transition metal carbonitride  $Ti_3CNT_x$  (MXene)"*



Bin Xu, BUCT, China

*Title: "MXene-based materials and electrodes for energy storage"*



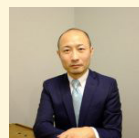
9:30 AM EST – 11:30 AM EST

**Future of MXene Research and Applications Panel**

**Moderator:** Yury Gogotsi, Drexel University, USA

**Panelists:**

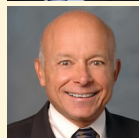
Takeshi Torita,  
Murata Manufacturing Co., Ltd., Japan



Terrance Barkan,  
The Graphene Council, USA



Michel W. Barsoum,  
Drexel University, USA





# Program

## Poster Presentations

### Monday, August 3<sup>rd</sup>, 2020 | Topic: Synthesis, Structure, and Properties

|                     |                                 |   |
|---------------------|---------------------------------|---|
| Anita Wojciechowska | Warsaw University of Technology | <i>"Insight into the interactions of 2D <math>Ti_3C_2</math> and <math>Ti_2C</math> MXenes with collagen"</i> |
| Asia Sarycheva      | Drexel University               | <i>"Raman spectroscopy of <math>Ti_3C_2T_x</math>"</i>  |
| Deependra Parajuli  | Andhra University               | <i>"Synthesis and Topological Analysis of <math>M_2'M_x</math> "Xene Oxides"</i>                              |
| Shuohan Huang       | Missouri S&T                    | <i>"Investigating Chemical Reactivity of MXenes Using Gas Analysis"</i>                                       |

### Tuesday, August 4<sup>th</sup>, 2020 | Topic: Electronic and Medical Applications

|                    |                            |  |
|--------------------|----------------------------|--|
| Emma Ward          | University of Brighton     | <i>"<math>Ti_3C_2T_x</math> in Adjustable Focus, Implantable Lens Design"</i>                      |
| Geetha Valurouthu  | Drexel University          | <i>"Tunable Electrochromic Behavior in Titanium-Based Mxenes"</i>                                  |
| Grace Cooksley     | University of Brighton     | <i>"Optoelectronic Nanomaterials to Reduce the Complications Associated with Cataract Surgery"</i> |
| Ji Liu             | Trinity College of Dublin  | <i>"<math>Ti_3C_2T_x</math> MXene foams toward electromagnetic interference shielding"</i>         |
| Mykola Seredych    | Drexel University          | <i>"MXene Sorbents for Removal of Uremic Toxins from Dialysate"</i>                                |
| Natalia Noriega    | University of Brighton     | <i>"MXenes as a potential biosensing platform for detection of ophthalmic biomarkers"</i>          |
| Nicolette Driscoll | University of Pennsylvania | <i>"Two-Dimensional <math>Ti_3C_2</math> MXene for High-Resolution Neural Interfaces"</i>          |

### Wednesday, August 5<sup>th</sup>, 2020 | Topic: Chemistry-Processing-Properties Relationships

|              |                     |   |
|--------------|---------------------|---|
| Jason Lipton | New York University | <i>"Scalable, highly conductive, and micropatternable MXene films for enhanced EMI Shielding"</i> |
|--------------|---------------------|---|

### Thursday, August 6<sup>th</sup>, 2020 | Topic: Energy Related Applications, from Modeling to Implementation

|                       |                                     |   |
|-----------------------|-------------------------------------|---|
| Agnieszka Jastrzębska | Warsaw University of Technology     | <i>"Juggling surface charges of 2D Niobium Carbide Mxenes for a reactive oxygen species scavenging and effective targeting of the malignant melanoma cell cycle into programmed cell death"</i> |
| Davi Marcelo Soares   | Kansas State University             | <i>"MXene Nanosheets as Alkali Metal-Ion Battery Electrodes: Initial Studies"</i>   |
| Muhammad Ihsan Ul Haq | HKUST                               | <i>"<math>Ti_2C</math> MXene for sodium metal batteries"</i>  |
| Shuangshuang Zhao     | Jilin University, Drexel University | <i>"Flexible <math>Nb_4C_3T_x</math> Film with Large Interlayer Spacing for High-Performance Supercapacitors"</i>   |
| Varun Natu            | Drexel University                   | <i>"Crumpled MXene as Anodes in Na-ion batteries"</i>   |
| Xuehang Wang          | Drexel University                   | <i>"Solvents' Influence on Charge Storage in 2D Titanium Carbide"</i>   |

### Friday, August 7<sup>th</sup>, 2020 | Topic: Chemistry-Processing-Properties Relationships

|                    |                      |  |
|--------------------|----------------------|--|
| Magdalena Birowska | University of Warsaw | <i>"Surface-related Features Responsible for Cytotoxic Behavior of Mxenes Layered Materials Predicted with Machine Learning"</i> |
|--------------------|----------------------|--|

All posters will be available to view throughout the conference.

Poster presenters will also participate in Q&A sessions on their scheduled dates from 11:30 AM to 12:30 PM EST

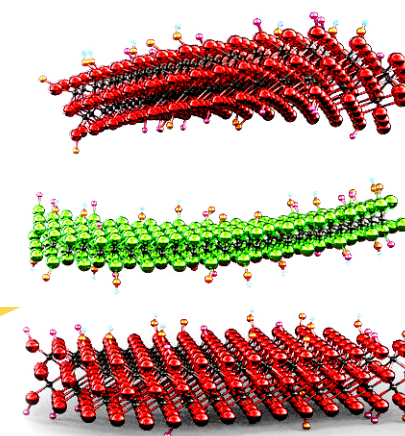


# Courses

Experienced researchers, industry professionals, and students are all welcome to partake in these in-depth courses preceding the MXene Conference.

Cost:  
**\$300 per course**  
**\$500 for both courses**

**Registration Deadline:** July 24<sup>th</sup>, 2020 at 5 PM EST  
[Register by Clicking Here](#)



## **MXenes Synthesis Course:**

This course will introduce researchers to MXene synthesis best practices. Course attendees will receive detailed instruction as well as laboratory tutorials on how to synthesize MXenes. Participants will also learn about common mistakes encountered during MXene synthesis and receive course materials to guide their future research. This course is a great resource for researchers new to the MXene field as well as current MXene researchers who want to further advance their skill set.

**Schedule:** July 27<sup>th</sup> and July 28<sup>th</sup>, 2020  
7:30 AM EST – 12 PM EST

## **MXenes Characterization Course:**

In this course, we will cover characterization of MXene powders, colloidal solutions, single flakes and films by Raman spectroscopy, electron microscopy, UV-vis, XPS and other techniques. Experienced researchers will teach you how to determine the quality, flake size, and delamination of MXenes on the example of  $\text{Ti}_3\text{C}_2\text{T}_x$ . Sample preparation and elimination of measurement artifacts will be discussed in detail. Interpretation of Raman, UV-vis and XPS spectra of various MXenes will be provided. Bring your spectra and images and discuss them with our experts.

**Schedule:** July 29<sup>th</sup> and July 30<sup>th</sup>, 2020  
7:30 AM EST – 12 PM EST





**Professor Yury Gogotsi**

Distinguished University and Charles T. and Ruth M. Bach Professor  
Director, A.J. Drexel Nanomaterials Institute  
Email: [gogotsi@drexel.edu](mailto:gogotsi@drexel.edu)

▶ Introduction and Opening Remarks



**Dr. Christopher E. Shuck**

Postdoctoral Research Associate  
A.J. Drexel Nanomaterials Institute  
Email: [ces378@drexel.edu](mailto:ces378@drexel.edu)

▶ Fundamentals of Etching/Delamination

▶ Demonstration of Etching/Delamination (Synthesis of  $\text{Ti}_3\text{C}_2\text{T}_x$ )



**Adam Goad**

Ph.D. Student  
A.J. Drexel Nanomaterials Institute  
Email: [azg29@drexel.edu](mailto:azg29@drexel.edu)

▶ MXene Etching Safety Protocols



**Dr. Armin Vahid Mohammadi**

Research Assistant Professor  
A.J. Drexel Nanomaterials Institute  
Email: [avm57@drexel.edu](mailto:avm57@drexel.edu)

▶ Synthesis of MXenes Beyond  $\text{Ti}_3\text{C}_2\text{T}_x$

July 28<sup>th</sup>, 2020



**Simge Uzun**

Ph.D. Candidate

A.J. Drexel Nanomaterials Institute

Email: su63@drexel.edu



**Introduction to Processing of MXene Dispersions**



**MXene Liquid Crystals and Fibers**



**Dr. Mikhail Shekhirev**

Research Associate

A.J. Drexel Nanomaterials Institute

Email: ms4986@drexel.edu



**Storage of MXenes and MXene Dispersions in Organic Solvents**



**Kanit Hantanasirisakul**

Ph.D. Candidate

A.J. Drexel Nanomaterials Institute

Email: kh654@drexel.edu



**Fabrication of 2D Transition Metal Carbide (MXene) Transparent Films**



**Asia Sarycheva**

Ph.D. Candidate

A.J. Drexel Nanomaterials Institute

Email: as4357@drexel.edu



**Size Selection of MXenes**





## Course Schedules

July 29<sup>th</sup>, 2020

**Professor Yury Gogotsi**

Distinguished University and Charles T. and Ruth M. Bach Professor  
Director, A.J. Drexel Nanomaterials Institute  
Email: [gogotsi@drexel.edu](mailto:gogotsi@drexel.edu)

**Introduction to MXene Characterization****Asia Sarycheva**

Ph.D. Candidate  
A.J. Drexel Nanomaterials Institute  
Email: [as4357@drexel.edu](mailto:as4357@drexel.edu)

**Raman Spectroscopy of MAX and MXene****Dynamic Light Scattering (DLS): Size and Zeta Potential****Dr. Christopher E. Shuck**

Postdoctoral Research Associate  
A.J. Drexel Nanomaterials Institute  
Email: [ces378@drexel.edu](mailto:ces378@drexel.edu)

**XRD Characterization of MAX Phases and MXene****Mark Anayee**

Ph.D. Student  
A.J. Drexel Nanomaterials Institute  
Email: [ma3636@drexel.edu](mailto:ma3636@drexel.edu)

**X-ray Photoelectron Spectroscopy of MXenes**

## Course Schedules

July 30<sup>th</sup>, 2020

**Mark Anayee**

Ph.D. Student

A.J. Drexel Nanomaterials Institute

Email: ma3636@drexel.edu



**Thermal Analysis of MXenes**

**Dr. Narendra Kurra**

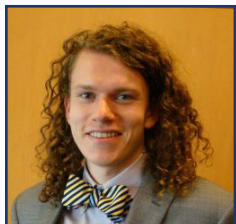
Research Assistant Professor

A.J. Drexel Nanomaterials Institute

Email: nk545@drexel.edu



**Electronic and Optical Properties of MXenes**

**Adam Goad**

Ph.D. Student

A.J. Drexel Nanomaterials Institute

Email: azg29@drexel.edu



**Transmission Electron Microscopy (TEM) of MXenes**

**Dr. Mikhail Shekhirev**

Research Associate

A.J. Drexel Nanomaterials Institute

Email: ms4986@drexel.edu



**Optical Microscopy & Scanning Electron Microscopy**



**Atomic Force Microscopy (AFM)**

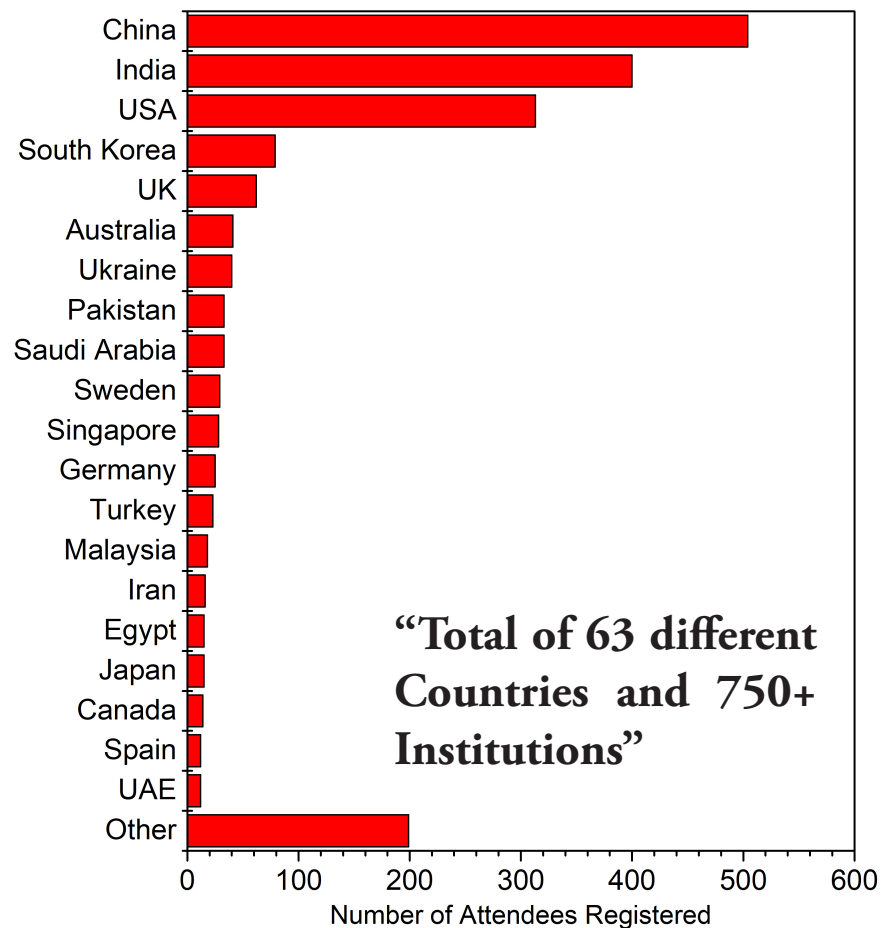


# Statistics

Total number of participants

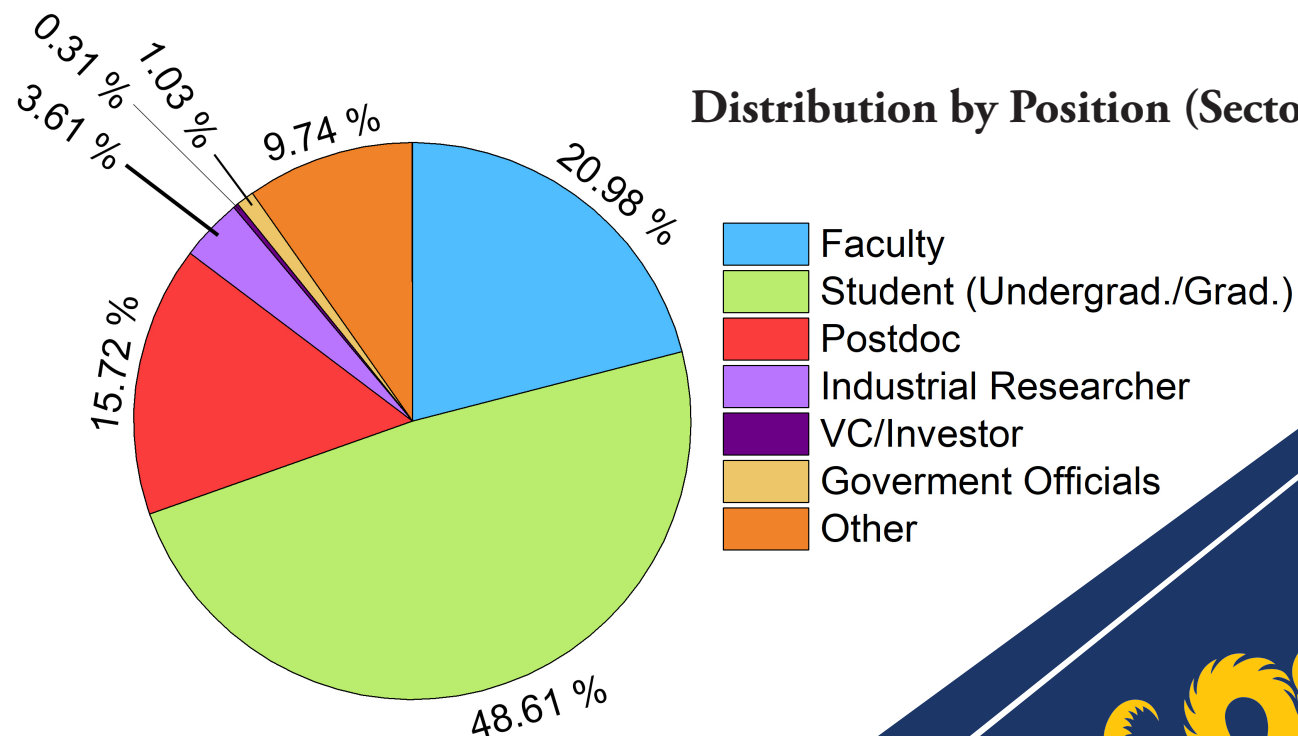
2000+

Distribution by Country



**“Total of 63 different Countries and 750+ Institutions”**

Distribution by Position (Sector)



# Sponsors

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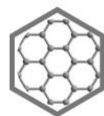
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## Silver Sponsors



## Bronze Sponsors



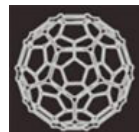
**The  
Graphene  
Council**

Cell Reports  
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**C** Journal of  
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