

Chang (Evelyn) Ren

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RESEARCH SUMMARY

My research is focused on **fabrication and ion-interaction-related properties** of 2D transition metal carbides **MXenes membranes**. By **electrochemical and permeation tests**, I'm dedicated to **understand the mechanism** of ion intercalation and permeation into MXene, and the effects of electrochemical driving force. Much of my research is collaborated with colleagues inside and outside Drexel, from which I improved my ability to **work and communicate effectively**.

EDUCATION

Drexel University, Philadelphia, PA, USA

Ph.D. Candidate

Department of Materials Science and Engineering (**MSE**)

Advisor: Prof. Yury Gogotsi, A.J. Drexel Nanomaterials Institute (**DNI**)

2011 – present, GPA: 3.85

Bachelor of Engineering in MSE

Northwestern Polytechnical University, Xi'an, China

2008 – 2012, GPA: 3.64, Rank: 5/88

SKILLS

- Fabrication and testing supercapacitors and batteries
 - Electrochemical characterization
 - Operational skills of chemistry (Vacuum assisted filtration, operating HF reactions, electro-spinning and powder annealing)
 - Characterizations: XRD, SEM, UV-VIS spectroscopy, four-point-probe conductivity measurement
 - Software: EC lab, Origin, MDI Jade, EndNote, VESTA Crystal Making, FactSage
 - Language: Chinese (native speaker), English (professional proficiency)
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SELECTED AWARDS

- 2nd place for poster "Cation Intercalation and High Volumetric Capacitance of Two-Dimensional Titanium Carbide", from 227th ECS meeting, Chicago IL, 29 May 2015
 - First Prize of Excellent Undergraduate Scholarship in 3 consecutive academic years (5%)
 - Golden Prize in "Sanhang Cup" Business Plan Competition (2/80)
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FUNDING RESOURCES

- Chinese Scholarship Council
 - Qatar Environment and Energy Research Institute (QEERI)
 - Department of Energy
 - Batteries for Advanced Transportation Technologies Program
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PUBLICATIONS

- C. E. Ren[†], M.-Q. Zhao[†], T. Makaryan, J. Halim, M. Boota, S. Kota, B. Anasori, M. W. Barsoum, Y. Gogotsi, Porous Two-Dimensional Transition Metal Carbide (MXene) Flakes for High-Performance Li-Ion Storage, submitted to **ChemElectroChem**.
 - C. E. Ren, K. B. Hatzell, M. Alhabeb, Z. Ling, G. R. Berdiyorov, M. E. Madjet, K. A. Mahmoud, Y. Gogotsi, Charge and Size Selective Ion Sieving Through Ti₃C₂T_x MXene Membranes, **J. Phys. Chem. Lett.** 6, (2015), pp. 4026-4031
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- Z. Ling[†], C. E. Ren[†], M.-Q. Zhao, J. Yang, J. M. Giammarco, J. Qiub, M. W. Barsouma, Y. Gogotsi, Flexible and conductive MXene films and nanocomposites with high capacitance, **Proc. Natl. Acad. Sci. USA** 111 (2014), pp. 16676–16681
 - M.-Q. Zhao[†], C. E. Ren[†], Z. Ling, M. R. Lukatskaya, C.-F. Zhang, K. L. Van Aken, M. Barsoum, Y. Gogotsi, **Adv. Mater.** 27 (2015), pp. 339-345
 - M. R. Lukatskaya, O. Mashtalir[†], C.E. Ren[†], Y. Dall'Agnese, P. Rozier, P. L. Taberna, M. Naguib, P. Simon, M.W. Barsoum, Y. Gogotsi, Cation Intercalation and High Volumetric Capacitance of Two-dimensional Titanium Carbide, **Science** 341 (2013), pp. 1502-1505
 - J.W. Li, C. Ren, Y. Meng, S.X. Gao, Effect of Homogenizing Process on Microstructure and Property of AZ31 Mg Alloy", **Hot Working Technology** 40, (2011), pp. 22-24

[†] Contributed equally.

RESEARCH EXPERIENCE

Electrochemical control of ion permeation through Ti₃C₂T_x membranes

Lead Researcher, 8/2015-present

- Build a device to exert voltage on Ti₃C₂T_x membranes and characterizing the effects of positive and negative voltages on Ti₃C₂T_x composed of different-sized nanosheets.
- Study the effects of electrochemical control on MXene interlayer spacing by XRD.

Porous Two-Dimensional Transition Metal Carbide (MXene) Flakes for High-Performance Li-Ion Storage,

Lead Researcher, 1/2015-present

- Develop a chemical etching method to produce porous Ti₃C₂T_x (p-Ti₃C₂T_x) at room temperature in aqueous solutions.
- Demonstrate the p-Ti₃C₂T_x has larger specific surface areas, and p-Ti₃C₂T_x/CNT films have significantly improved lithium ion storage capabilities.
- Submitted manuscript to *ChemElectroChem*.

Charge- and Size-Selective Ion Sieving Through Ti₃C₂T_x MXene Membranes

Lead Researcher, DNI/QEERI, 12/2014-9/2015

- Characterized the ultrafast water flux through micrometer-thick MXene membranes.
- Demonstrated differential sieving of salts depending on both their hydration radius and charge.
- Results published in *J. Phys. Chem. Lett.* (2015).

Flexible MXene/Carbon Nanotube Composite Paper with High Volumetric Capacitance

Lead Researcher, 2/2014-11/2014.

- Developed a simple, alternating filtration method to achieve the sandwich-like assembly of MXenes and carbon nanoparticles from aqueous suspensions.
- Electrochemically tested the capacitive performance of MXene/carbon nanoparticles, which showed increased volumetric capacity and rate performance.
- Results published in *Adv. Mater.* (2014).

Flexible and conductive MXene films and nanocomposites with high capacitance

Lead Researcher, 12/2013-9/2014

- Fabricated flexible nanocomposite films by mixing MXene with polymer (PVA or PDDA), which showed improved mechanical strength while remaining electrical conductivity.
 - Electrochemically tested the capacitive performance of MXene/PVA, which showed enhanced cationic intercalation and impressive volumetric capacitance.
 - Results published in *Proc. Natl. Acad. Sci. USA* (2014).
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Cation intercalation and high volumetric capacitance of two-dimensional titanium carbide

Researcher, 11/2012-9/2013

- Fabricated multilayered and delaminated $Ti_3C_2T_x$ paper which is highly flexible and electrical conductive.
- Electrochemically tested the capacitive performance of MXene electrodes.
- Results published in *Science* (2013).

Homogenizing to Improve Microstructure and Property of AZ31 Mg Alloy

Researcher, 4/2010-11/2011

- Homogenized Mg alloy at various temperature for various time; did metallography analysis and tensile-strength measurement.
- Results published in *Hot Working Technology* (2011).

SIDE PROJECTS

- Antibacterial Activity of $Ti_3C_2T_x$ MXene, in collaboration with QEERI and University of Brighton
- Low Temperature Conductivity and Magnetic Performance of MXene Films, in collaboration with Oxide Films & Interfaces Group, Drexel University
- High volumetric capacitance of Ti_3C_2 MXene film (LiF/HCl etched), Mentor of Star Scholars Program of Drexel
- Work function analysis of MXene, in collaboration with SMIF, Duke University

PRESENTATIONS

- Oral presentation at 2014 MRS Fall Meeting, Nov 30-Dec 5, 2014, Boston MA on "Flexible and conductive MXene polymer nanocomposites with high volumetric capacitance"
- Oral presentation at 227th ECS meeting, May 24-28, 2015, Chicago IL on "MXene-Based Membranes As Novel Materials for Ion Separation"
- Poster presentation at 2015 MRS Spring Meeting, Apr 6-10, 2015, San Francisco CA on "MXene-based Membranes as Novel Materials for Highly Selective Ion Permeation"

EXTRA CURRICULAR ACTIVITIES

- Journalist and press secretary of a student website, interviewed 100+ individuals and activities
 - Class president of Elite English class (TOP1%)
 - Jogging, hiking and sketching
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