

# RMW18



## The 18th Workshop on Reactive Metal Processing

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**March 28 (Fri.) – 29 (Sat.), 2025 @ Boston/Cambridge**

(After TMS 2025, March 23 (Sun.) – 27 (Thu.), 2025 @ Las Vegas, Nevada)

### **Organizers:**

**Donald R. Sadoway**

**Toru H. Okabe**

**Antoine Allanore**

**Shunsuke Yagi**

*Massachusetts Institute of Technology*

*Institute of Industrial Science (IIS),*

*The University of Tokyo*

*Massachusetts Institute of Technology*

*IIS, The University of Tokyo*

### **Program Coordinators:**

**Takanari Ouchi**

**Gen Kamimura**

**Isaac Oda-Bayliss**

**Gavin Winter**

**Kai Shimada**

*IIS, The University of Tokyo*

*Massachusetts Institute of Technology*

*IIS, The University of Tokyo*

*Massachusetts Institute of Technology*

*IIS, The University of Tokyo*

### **Sponsors**

- The Rare Metal Research Workshop, one of the Special Research Groups organized by the Foundation for the Promotion of Industrial Science (FPIS)
- (RC-40: directed by Prof. T. H. Okabe, RC-104: directed by Prof. S. Yagi)
- Research Center for Sustainable Material Energy Integration (SUSMAT)
- Institute of Industrial Science, The University of Tokyo (IIS UTokyo SYMPOSIUM No.123)

<http://www.okabe.iis.u-tokyo.ac.jp/core-to-core/rmw>

# The 18th Workshop on Reactive Metal Processing (IIS UTokyo SYMPOSIUM No.123)

March 28 (Fri.) – March 29 (Sat.), 2025, MIT, Cambridge, MA

## Time:

- 1st day: on March 28 (10:00 – 17:00 and Banquet at 18:30)
  - 2nd day: on March 29 (10:00 – 14:00)
- Refreshments will be served around 9:00 AM on both days.

## Venue:

- **Haus Allen Room (MIT)**
- **Le Méridien Cambridge**

## Registration Fee:

\$300 / person

## Organizers:

<b>Prof. Donald R. Sadoway</b>	<i>Massachusetts Institute of Technology</i>
<b>Prof. Toru H. Okabe</b>	<i>IIS, The University of Tokyo</i>
<b>Prof. Antoine Allanore</b>	<i>Massachusetts Institute of Technology</i>
<b>Prof. Shunsuke Yagi</b>	<i>IIS, The University of Tokyo</i>

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<b>Takanari Ouchi</b>	<i>IIS, The University of Tokyo</i>
<b>Gen Kamimura</b>	<i>Massachusetts Institute of Technology</i>
<b>Isaac Oda-Bayliss</b>	<i>IIS, The University of Tokyo</i>
<b>Gavin Winter</b>	<i>Massachusetts Institute of Technology</i>
<b>Kai Shimada</b>	<i>IIS, The University of Tokyo</i>

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## Contact:

Kai Shimada, *IIS, The University of Tokyo*  
E-mail: [shimada-kai079@g.ecc.u-tokyo.ac.jp](mailto:shimada-kai079@g.ecc.u-tokyo.ac.jp)

# Workshop Program

## Day 1

Morning, March 28 (Friday), 2025 @ Haus Allen Room (MIT)

9:00 – 10:00 **Coffee & Breakfast Service**

10:00 – 10:10 **Opening Remarks**

*Prof. Antoine Allanore*

*Massachusetts Institute of Technology*

Session Chair: *Prof. Antoine Allanore*

10:10 – 10:40 **Brine to Battery™: Electrolytic Production of Li-metal Electrodes: Introducing the lithium - vanadium oxide cell**

*Donald R. Sadoway*

*Massachusetts Institute of Technology*

10:40 – 11:00 **Break**

Session Chair: *Prof. Adam C. Powell, IV*

11:00 – 11:30 **Metal Nanoparticle Synthesis - Liquid Phase Process Design Using Potential-pH Diagram -**

*Shunsuke Yagi*

*IIS, The University of Tokyo*

11:30 – 12:00 **Sulfidation to Enhance the Physico-chemical Separation of Ternary Oxides, a Thermodynamic Study**

*Charles Boury*

*Massachusetts Institute of Technology*

12:00 – 13:00 **Lunch**

Session Chair: *Dr. Takanari Ouchi*

13:00 – 13:30 **Direct Carbon Fuel Cell for High-Efficiency Bioenergy with Carbon Capture**

*Adam C. Powell, IV*

*Worcester Polytechnic Institute*

13:30 – 14:00 **TBD**

*Raluca O. Scarlat*

*University of California, Berkeley*

14:00 – 14:20 **Photo & Break**

Session Chair: *Dr. Gen Kamimura*

14:20 – 15:20 **3-min Short Presentation by Poster Presenters**

15:20 – 16:20 **Poster Session at the Haus Room and Allen Room at Building 36**

18:00 – **Reception** @ Le Méridien Cambridge

18:30 – **Banquet** @ Le Méridien Cambridge

## Day 2

Morning, March 29 (Saturday), 2025 @ Haus Allen Room (MIT)

9:00 – 10:00 **Coffee & Breakfast Service**

10:00 – 10:10 **Opening Remarks**

*Prof. Shunsuke Yagi*

*IIS, The University of Tokyo*

Session Chair: *Prof. Shunsuke Yagi*

10:10 – 10:40 **Building Electricity Infrastructure and Electrifying Metals Production**

*Katrin E. Daehn*

*Massachusetts Institute of Technology*

10:40 – 11:00 **Break**

Session Chair: **Chair TBD**

11:00 – 11:30 **Electrochemical Extraction of Minor Elements from Metals**

*Takanari Ouchi*

*IIS, The University of Tokyo*

11:30 – 12:00 **Containerless Methods for High-throughput Property Measurement of Alloy Melts**

*Ethan Benderly-Kremen*

*Massachusetts Institute of Technology*

12:00 – 12:10 **Information for the Next RMW**

*Prof. Toru H. Okabe*

*IIS, The University of Tokyo*

12:10 – 12:20 **Closing Remarks**

*Prof. Donald R. Sadoway*

*Massachusetts Institute of Technology*

12:20 – 13:30 **Lunch**

13:30 – **Laboratory Tour**

## List of Poster Presenters

- 1. The Catalytic Activity of Transition Metal Doped  $\alpha$ -MnO<sub>2</sub> for Oxygen Evolution Reaction**  
*Kai Shimada*<sup>1,2</sup>,  
<sup>1</sup>Department of Materials Engineering, Graduate School of Engineering, The University of Tokyo  
<sup>2</sup>Institute of Industrial Science, The University of Tokyo
- 2. Solvoacidity in Molten Fluoride Salts**  
*Haley Williams*,  
<sup>1</sup>University of California, Berkeley
- 3. Understanding Fundamental Mechanisms for Electrochemical Reduction of Iron Oxide in Aqueous Alkaline Media**  
*Gavin Winter*<sup>1</sup>,  
<sup>1</sup>Massachusetts Institute of Technology
- 4. The Effect of Temperature for Hematite Sulfidation with Elemental Sulfur**  
*Matthew Mickalek*<sup>1</sup>,  
<sup>1</sup>Massachusetts Institute of Technology
- 5. Electrochemical Measurement of Dissolved Non-Metallic Contamination in Molten Salts**  
*Nathan Bradshaw*<sup>1</sup>,  
<sup>1</sup>Massachusetts Institute of Technology
- 6. Behavior of Phosphate in Sulfur-rich Systems**  
*Ava Waitz*<sup>1</sup>,  
<sup>1</sup>Massachusetts Institute of Technology
- 7. Recent Progress of Displacement Batteries**  
*Kashif Mushtaq*<sup>1</sup>,  
<sup>1</sup>Iberian Center for Research in Energy Storage CIIAE
- 8. Study on Reduction of MnO by Bio-carbon for Carbon-neutral Ferromanganese Production**  
*Shingo Katayama*<sup>1</sup>,  
<sup>1</sup>Nippon Denko Co. Ltd

## List of Poster Presenters

9. **Effect of Cell Structure on the Distribution of Surface Current Density in Rechargeable Mg Batteries Through Simulation**  
*Tamura Atsushi*<sup>1</sup>,  
<sup>1</sup>Institute of Industrial Science, The University of Tokyo
10. **Conductivity of BaS-La<sub>2</sub>S<sub>3</sub> Electrolyte for Electrolysis of FeS**  
*Natalie Chapman*<sup>1</sup>,  
<sup>1</sup>Massachusetts Institute of Technology
11. **A process for carbon-free deoxidation of CO<sub>2</sub> to produce CO based on the coupling of gas-liquid reaction and steel-slag electrolysis**  
*Wenhe Wu*<sup>1</sup>,  
<sup>1</sup>School of Materials Science and Engineering, Shanghai University
12. **Carbo-sulfidation of BaSO<sub>4</sub> in the Presence of FeS**  
*Gen Kamimura*<sup>1</sup>,  
<sup>1</sup>Massachusetts Institute of Technology
13. **Flow Electrolysis for Iron Production**  
*Omid Mahdavi*<sup>1</sup>,  
<sup>1</sup>Worcester Polytechnic Institute
14. **Preliminary exploration of electrochemical anodic deposition process for recycling of PGMs**  
*Momoka Imoto*<sup>1,2</sup>,  
<sup>1</sup>Department of Materials Engineering, Graduate School of Engineering, The University of Tokyo  
<sup>2</sup>Institute of Industrial Science, The University of Tokyo
15. **TBD**  
*Isaac Oda-Bayliss*<sup>1</sup>,  
<sup>1</sup>Institute of Industrial Science, The University of Tokyo
16. **Mapping the Pseudo-ternary FeS-BaS-La<sub>2</sub>S<sub>3</sub> Composition Space to Inform Molten Sulfide Electrolysis**  
*Eve Meltzer*<sup>1</sup>,  
<sup>1</sup>Massachusetts Institute of Technology
17. **Methane Decomposition Enabled by Molten Alkali Halide Electrolysis**  
*Xiaofei Guan*<sup>1</sup>,  
<sup>1</sup>ShanghaiTech University

## History of RMW

- 2006 **The 1st Workshop on Reactive Metal Processing (RMW1)**  
March 17 (Fri.) - March 19 (Sat.), Cambridge, MIT
- 2006 **The 2nd Workshop on Reactive Metal Processing (RMW2)**  
November 16 (Thurs.) - November 17 (Fri.), Tokyo, The University of Tokyo
- 2007 **The 3rd Workshop on Reactive Metal Processing (RMW3)**  
March 2 (Fri.) - March 3 (Sat.), Cambridge, MIT
- 2008 **The 4th Workshop on Reactive Metal Processing (RMW4)**  
March 14 (Fri.) - March 15 (Sat.), Cambridge, MIT
- 2010 **The 5th Workshop on Reactive Metal Processing (RMW5)**  
February 18 (Thurs.) - February 19 (Fri.), Seattle, Red Lion Hotel on 5th Avenue
- 2011 **The 6th Workshop on Reactive Metal Processing (RMW6)**  
March 4 (Fri.) - March 5 (Sat.), Pasadena, Caltech
- 2012 **The 7th Workshop on Reactive Metal Processing (RMW7)**  
March 16 (Fri.) - March 17 (Sat.), Cambridge, MIT
- 2013 **The 8th Workshop on Reactive Metal Processing (RMW8)**  
March 8 (Fri.) - March 9 (Sat.), Cambridge, MIT
- 2014 **The 9th Workshop on Reactive Metal Processing (RMW9)**  
February 21 (Fri.) - February 22 (Sat.), Pasadena, Caltech
- 2015 **The 10th Workshop on Reactive Metal Processing (RMW10)**  
March 20 (Fri.) - March 21 (Sat.), Cambridge, MIT
- 2016 **The 11th Workshop on Reactive Metal Processing (RMW11)**  
February 19 (Fri.) - February 20 (Sat.), Cambridge, MIT
- 2017 **The 12th Workshop on Reactive Metal Processing (RMW12)**  
March 3 (Fri.) - March 4 (Sat.), Cambridge, MIT
- 2018 **The 13th Workshop on Reactive Metal Processing (RMW13)**  
March 16 (Fri.) - March 17 (Sat.), Cambridge, MIT
- 2019 **The 14th Workshop on Reactive Metal Processing (RMW14)**  
March 15 (Fri.) - March 16 (Sat.), Cambridge, MIT
- 2020 **The 15th Workshop on Reactive Metal Processing (RMW15)**  
February 28 (Fri.) - February 29 (Sat.), San Diego, UC San Diego
- 2023 **The 16th Workshop on Reactive Metal Processing (RMW16)**  
March 24 (Fri.) - March 25 (Sat.), Cambridge, MIT
- 2024 **The 17th Workshop on Reactive Metal Processing (RMW17)**  
March 24 (Fri.) - March 25 (Sat.), Cambridge, MIT

**RMW1 in 2006 at MIT**



**RMW2 in 2006 at IIS**



**RMW5 in 2010 at Seattle**



**RMW17 in 2024 at MIT**



## List of Participants

Adam Powell	Associate Professor	WPI
Aindrea Campbell	Materials Engineer	Apple Inc.
Antoine Allanore	Professor	MIT
Artem Iurkovskiy	Undergraduate Student	WPI
Atsushi Tamura	Project Assistant Professor	The University of Tokyo
Ava Waitz	Graduate Research Assistant	MIT
Ayato Katayama	Researcher	Nippon Denko Co., Ltd.
Bohdana Naidych	Postdoctoral Researcher	Sadoway Labs Foundation
Caspar Stinn	Principal Scientist	Outokumpu
Charles Boury	Ph.D. MBA student	MIT
Daniel Mc Arthur Sehar	Postdoctoral researcher	WPI
Donald R. Sadoway	Professor Emeritus	MIT, Sadoway Labs
Eli Brosh	Researcher	Nuclear Research Center Negev
Erez Boukobza	Researcher	Nuclear Research Center Negev, Tel Aviv University
Ethan Benderly-Kremen	Graduate student	MIT
Eve Meltzer	PhD Candidate	MIT
Gavin Winter	PhD student	MIT
Gen Kamimura	Postdoctoral Fellow	Massachusetts Institute of Technology
Guillaume Lambotte	Chief Scientist	Boston Metal
Haley Williams	PhD Student	University of California, Berkeley
Henry Hutcheson	Scientist	Outokumpu Stainless
Hiroyuki Iwasaki	SSHE Advisor	ExxonMobil Japan Products Technology Center
Hrishikesh Nirgude	Research Assistant	WPI
Isaac Oda-Bayliss	Research Associate	The University of Tokyo
Joe Lessard	Materials Engineer	Apple Inc.
Jonathan Lambole	Senior Expert in pyrometallurgy	Eramet
Jonathan Paras	Harry S. Truman Fellow	Sandia National Laboratories
Kai Shimada	Graduate student	The University of Tokyo
Kali Simonds	Staff Engineer	Sadoway Labs Foundation
Karthik Vinayagam	Student	WPI
Kashif Mushtaq	Senior Researcher	Iberian Center for Research in Energy Storage CIIAE
Katrin Daehn	Research scientist	MIT



## List of Participants

Kimaya Suryarao	Senior Scientist	Outokumpu
Lucas Marden	Scientist	Outokumpu
M. Akbar Rhamdhani	Professor	Swinburne University of Technology
Maika Sakamoto	Administrative staff	IIS
Manisha Dahal	Analysis engineer	Sadoway labs foundation
Masatoshi Ueno	Managing Director	Komatsu
Matthew Michalek	Research Assistant	MIT
Matthew Humbert	Staff Scientist	Sadoway Labs Foundation
Michael Abere	Staff Scientist	Sandia National Labs
Mohammad Ibrahim	Postdoctoral researcher	NTNU, Trondheim
Momoka Imoto	Graduate Student	IIS, The University of Tokyo
Natalie Chapman	RA	MIT
Nathan Bradshaw	Graduate Student	MIT
Omid Mahdavi	PhD student	WPI
Peace Kim	Senior Research Scientist	Phoenix Tailings
Peter Poulos	Undergraduate BS candidate	WPI
Ragnhild Aune	Professor	NTNU
Raluca Scarlat	Associate Professor	UC Berkeley
Rich Bradshaw	COO	Sadoway Labs Foundation
Ryota Tezuka	Administrative staff	IIS
Sami Meddeb	Pyrometallurgical engineer	Eramet
Shingo Katayama	Executive Adviser of R&D	NIPPON DENKO Co. Ltd.
Shunsuke Yagi	Associate Professor	IIS
Tadeu Carneiro	CEO	Boston Metal
TAEHYUK LEE	Senior Researcher	KIGAM
Takanari Ouchi	Assistant Professor	IIS
Tomás Villalón Jr.	CTO	Phoenix Tailings
Toru H. Okabe	Professor	IIS
Wenhe Wu	Associate Professor	Shanghai University
Xiaofei Guan	Assistant Professor	ShanghaiTech University
Xueqi Pang	Postdoctoral Researcher	Sadoway Labs Foundation

## List of Guest Participants

Jianlu Zheng	Postdoc Associate	MIT
Kazumi Wada	Professor	The University of Tokyo, MIT
Ryosei Nakama	Undergraduate Student	The University of Tokyo
Tamaki Yamamoto	Undergraduate Student	The University of Tokyo
Toshiki Okayasu	Undergraduate Student	The University of Tokyo
Wataru Morioka	Undergraduate Student	The University of Tokyo
Yu Nishiuchi	Undergraduate Student	The University of Tokyo

## Venue Details

### Workshop:

Haus Allen Room

Building 36, Room 462 (4th floor)

50 Vassar St, Cambridge, MA 02139

Interactive Campus Map available at: <http://whereis.mit.edu/>

### Banquet:

Le Méridien Boston Cambridge

20 Sidney St, Cambridge, MA 02139

