

RMW12

The 12th Workshop on Reactive Metal Processing

March 3 (Fri.) - 4 (Sat.), 2017 @ MIT
Cambridge, Massachusetts, USA

Organizers

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

Program Coordinators

Ryohei Yagi,	<i>IIS, The University of Tokyo</i>
Bradley R. Nakanishi,	<i>Massachusetts Institute of Technology</i>
Yu-ki Taninouchi,	<i>IIS, The University of Tokyo</i>

Sponsors

- The Rare Metal Research Workshop, one of the Special Research Group organized by the Foundation for the Promotion of Industrial Science (FPIS) (RC-40: directed by Prof. T. H. Okabe)
- Donation to The University of Tokyo New York Office by Dowa Metals & Mining Co., Ltd., Mitsubishi Materials Corporation, Sumitomo Metal Mining Co., Ltd., and Tanaka Kikinzoku Kogyo K.K..
- IIS UTokyo Symposium # 87 by the Foundation for the Promotion of Industrial Science (FPIS)
- Grant-in-Aid for Scientific Research (S) by JSPS (Project No. 26220910)
- The Strategic Partnerships Project of the Top Global University Project by The University of Tokyo

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

The 12th Workshop on Reactive Metal Processing

March 3 (Fri.) – March 4 (Sat.), 2017, MIT, Cambridge, MA

Time:

- 1st day: on March 3 (9:30 – 17:15 and Banquet at 18:30)
- 2nd day: on March 4 (9:30 – 13:30)

Refreshments will be served around 8:30 AM on both days.

Venue:

- **Microsoft NERD Center for Workshop (Horace Mann Room)**
Poster session is held at the Microsoft NERD Center on March 3, 2017.
- **MIT Museum for Banquet** (<https://mitmuseum.mit.edu/>)

Registration Fee:

\$200 / person (\$50 for students)

NOTICE: Please prepare to pay the registration fee in cash!

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- Prof. Antoine Allanore**, *Massachusetts Institute of Technology*
- Prof. Shunsuke Yagi**, *IIS, The University of Tokyo*
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Contact:

Ryohei Yagi, *IIS, The University of Tokyo*

E-mail: r-yagi@iis.u-tokyo.ac.jp

Workshop Program

Day 1

Morning, March 3 (Friday), 2017 @ Horace Mann Room in the Microsoft NERD Center

8:30 – 9:30 **Coffee & Breakfast Service**

9:30 – 9:40 **Opening Remarks**

Prof. Donald R. Sadoway, Massachusetts Institute of Technology

Prof. Toru H. Okabe, IIS, The University of Tokyo

Session Chair: Dr. Yu-ki Taninouchi

9:40 – 10:10 **“Electrochemical Methods for the Investigation of High Temperature Molten Oxide Systems”**

*Antoine Allanore*¹

¹Massachusetts Institute of Technology

10:10 – 10:40 **“Quadruple Perovskite Catalysts for Oxygen Evolution Reaction”**

*Shunsuke Yagi*¹

¹Institute of Industrial Science, The University of Tokyo

10:40 – 10:55 **Break**

Session Chair: Prof. Georges J. Kipouros

10:55 – 11:25 **“Electrodeposition of Silicon for Photovoltaic Applications”**

*Ji Zhao*¹ and Donald R. Sadoway¹

¹Massachusetts Institute of Technology

11:25 – 11:55 **“Viscosity Measurement of High-Temperature Melts for Materials Processings”**

*Osamu Takeda*¹

¹Tohoku University

11:55 – 12:25 **“Methane-supplied Gas Anodes for Electrowinning of Aluminium”**

*Babak Khalaghi*¹, Tommy Mokkalbost², Ole Sigmund Kjos²,

Geir Martin Haarberg¹

¹Norwegian University of Science and Technology

²SINTEF Materials and Technology

12:25 – 13:30 **Lunch**

Afternoon, March 3 (Friday), 2017 @ Horace Mann Room in the Microsoft NERD Center

Session Chair: Prof. Shunsuke Yagi

13:30 – 14:00 **“The Role of Rare Earths in Energy Conversion Higher Efficient Systems”**

*Georges J. Kipouros*¹

¹University of Saskatchewan

14:00 – 14:30 **“Vapor Treatment for Alloying and Magnetizing Platinum Group Metals”**

Yu-ki Taninouchi and Toru H. Okabe¹

¹Institute of Industrial Science, The University of Tokyo

14:30 – 15:00 **“Investigation and Mitigation of Chromium Poisoning of Perovskite Cathodes at High Temperatures”**

*Uday B. Pal*¹ and Ruofan Wang¹

¹Boston University

15:00 – 15:15 **Photo & Break**

15:15 – 16:15 **3-min Short Presentation by Poster Presenters**

16:15 – 17:15 **Poster Session**

18:30 – **Banquet** @ MIT Museum

Day 2

Morning, March 4 (Saturday), 2017 @ Horace Mann Room in the Microsoft NERD Center

8:30 – 9:30 **Coffee & Breakfast Service**

9:30 – 9:40 **Opening Remarks**

Prof. Antoine Allanore, Massachusetts Institute of Technology

Prof. Shunsuke Yagi, IIS, The University of Tokyo

Session Chair: Prof. Osamu Takeda

9:40 – 10:10 **“Alternating Current Voltammetry Theory of Metal Reduction during High Temperature Electrolysis”**

*Andrew Caldwell*¹ and *Antoine Allanore*¹

¹Massachusetts Institute of Technology

10:10 – 10:40 **“Quantum Beam Technology: Metallic Nanostructures Prepared by Ion Beam Irradiation for Electrochemical Devices”**

*Tetsuya Yamaki*¹

¹National Institutes for Quantum and Radiological Science and Technology

10:40 – 11:00 **Break**

Session Chair: Prof. Antoine Allanore

11:00 – 11:30 **“Electrodeposition of Titanium in MgCl₂-NaCl-KCl”**

*Kouhei Funatsu*¹, *Yuki Yamada*¹, *Akihiro Kishimoto*¹, and *Tetsuya Uda*¹

¹Department of Materials Science and Engineering, Kyoto University

11:30 – 12:00 **“Effect of Additives on Current Efficiency for Aluminium Deposition from Cryolite-Based Electrolytes”**

Taiki Morishige^{1,2}, *Geir Martin Haarberg*¹, *Henrik Gudbrandsen*³,
*Egil Skybakmoen*³, and *Asbjørn Solheim*³

¹Norwegian University of Science and Technology

²Kansai University

³SINTEF Materials and Chemistry

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 (for applicants)**

List of Poster Presentations

- 1. “Thermal Imaging Furnace Technique for Ultra-High Temperature Electrochemical Measurements”**
*Bradley Nakanishi*¹ and Antoine Allanore¹
¹Massachusetts Institute of Technology
- 2. “Scaling Up Molten Sulfide Electrolysis: Electrochemical Engineering Considerations”**
*Brian Chmielowiec*¹ and Antoine Allanore¹
¹Massachusetts Institute of Technology
- 3. “Molten Semiconductors for High Temperature Thermoelectricity”**
*Youyang Zhao*¹ and Antoine Allanore¹
¹Massachusetts Institute of Technology
- 4. “Extraction of Cu, Mo and Re from Sulfide Electrolyte Melt”**
*Sulata Kumari Sahu*¹ and Antoine Allanore¹
¹Massachusetts Institute of Technology
- 5. “Phase Equilibria in the BaO-ZrO₂-Y₂O₃-NiO System at 1500°C”**
*Katsuhiro Ueno*¹, Naoyuki Hatada¹, Donglin Han¹, Yuki Otani¹, Akiko Kuramitsu¹,
and Tetsuya Uda¹
¹Department of Materials Science and Engineering, Kyoto University
- 6. “Investigation of La₂(M_{1-x}RE_x)₂O_{7-δ} (M = Nb, Ta ; RE = Rare Earth Element) Based Ionic Conductor”**
*Kouhei Kato*¹, Donglin Han¹, and Tetsuya Uda¹
¹Department of Materials Science and Engineering, Kyoto University
- 7. “Non-Empirical Calculation of Thermodynamic Properties of Liquid Transition Metal Alloys”**
*Shun Ueda*¹ and Kazuki Morita¹
¹Department of Materials Engineering, The University of Tokyo
- 8. “Heterogeneous Nucleation Mechanism of Copper Sulfate Hydrate on Copper Alloys”**
Yuma Ninomiya^{1,2} Hideaki Sasaki³, Takeshi Yoshikawa², and Masafumi Maeda²
¹Department of Materials Engineering, The University of Tokyo
²Institute of Industrial Science, The University of Tokyo
³Materials Science and Engineering, Graduate School of Science and Engineering, Ehime University

9. **“Evaluation on the Heterogeneous Nucleation of Graphite on Non-Metallic Inclusions in Fe-C-Si Alloys”**
Kok Long NG^{1,2}, Hideaki Sasaki³, Hisao Kimura², Takeshi Yoshikawa², and Masafumi Maeda²
¹Department of Materials Engineering, The University of Tokyo
²Institute of Industrial Science, The University of Tokyo
³Materials Science and Engineering, Graduate School of Science and Engineering, Ehime University

10. **“Development of Novel Recycling Process of Precious Metals from Waste of Electrical Electronic Equipment Using Organic Aqua Regia”**
Akihiro Yoshimura¹ and Yasunari Matsuno²
¹Institute of Industrial Science, the University of Tokyo
²Graduate School of Engineering, Chiba University

11. **“Nickel and Rhenium Separation from Ni-based Superalloy Scraps by Using Molten Bi-Zn”**
Ryohei Yagi^{1,2} and Toru H. Okabe²
¹Department of Materials Engineering, The University of Tokyo
²Institute of Industrial Science, The University of Tokyo

12. **“Development of New Technology for High-Speed Production of Copper”**
Kanta Iwaya^{1,2} and Toru H. Okabe²
¹Department of Materials Engineering, The University of Tokyo
²Institute of Industrial Science, The University of Tokyo

13. **“Thermodynamic Considerations of Titanium Deoxidation by Rare-Earth Metals”**
Chenyi Zheng^{1,2}, Yu-ki Taninouchi², and Toru H. Okabe²
¹Department of Materials Engineering, The University of Tokyo
²Institute of Industrial Science, The University of Tokyo

14. **“Performance of iridium containing nickel base superalloy tool for friction stir welding of Ti-6Al-4V alloy”**
Kunihiro Tanaka¹, Tatsuya Nakazawa¹, Koichi Sakairi¹, Yutaka S. Sato², Hiroyuki Kokawa², Toshihiro Omori², Kiyohito Ishida², and Satoshi Hirano³
¹ Tanaka Kikinzoku Kogyo K.K.
²Tohoku University
³Hitachi, Ltd.

15. **“Workshop on Reactive Metal Processing (Introduction of RMWs)”**

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

RMW1 in 2006 at MIT



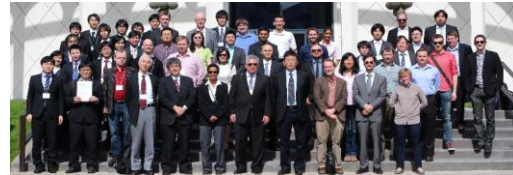
RMW2 in 2006 at IIS



RMW5 in 2010 in Seattle

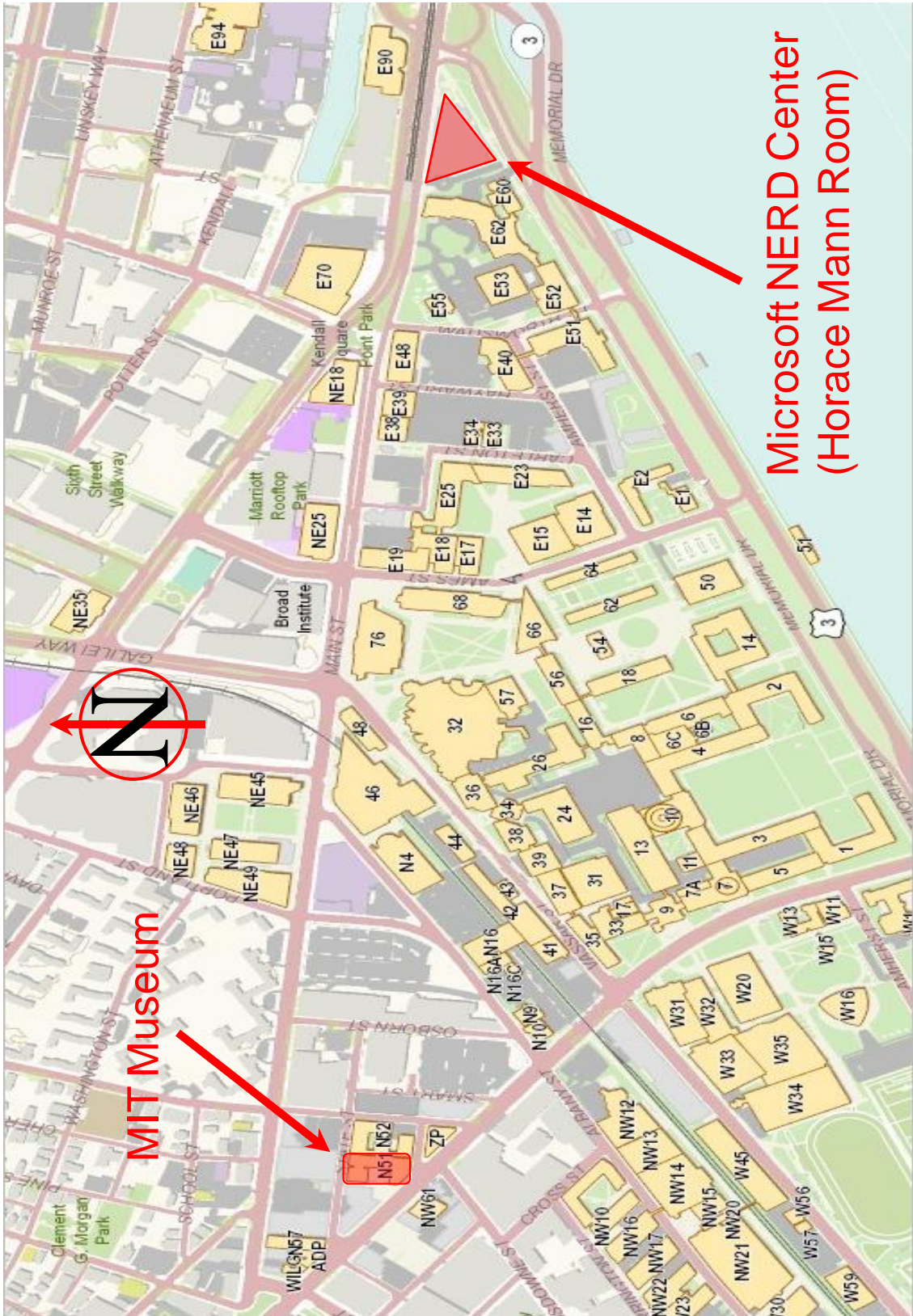


RMW9 in 2014 at CALTECH



RMW11 in 2016 at MIT





MIT Museum

Microsoft NERD Center
(Horace Mann Room)

Announcement for Next Workshop

RMW13

The 13th Workshop on
Reactive Metal Processing



March 16 (Fri.) – 17 (Sat.), 2018 @ MIT, Cambridge

(After TMS 2018, March 11 – March 15, 2018
@ Phoenix, Arizona)

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Mary E. Wagner, *Massachusetts Institute of Technology*

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List of Participants

Akihiro Yoshimura	Project Researcher	The University of Tokyo
Andrew Caldwell	Ph.D Candidate	MIT
Antoine Allanore	Assistant Professor	MIT
Babak Khalaghi	Ph.D Candidate	NTNU
Benjamin Sabatini	Postdoctoral Research Specialist	MIT
Bradley R. Nakanishi	Ph.D Candidate	MIT
Brian Chmielowiec	Graduate Student	MIT
Chenyi Zheng	Graduate Student	The University of Tokyo
Donald R. Sadoway	Professor	MIT
Georges J. Kipouros	Professor	University of Saskatchewan
Hilary Sheldon	Administrative Staff	MIT, Prof. Sadoway's secretary
Hiroyuki Matsuura	Associate Professor	The University of Tokyo
Huayi Yin	Postdoctoral Associate	MIT
Ji Zhao	Postdoctoral Associate	MIT
Kanta Iwaya	Graduate Student	The University of Tokyo
Katsuhiko Ueno	Graduate Student	Kyoto University
Kazuki Morita	Professor	The University of Tokyo
Kouhei Funatsu	Graduate Student	Kyoto University
Kouhei Kato	Graduate Student	Kyoto University
Kunihiro Tanaka	Section Chief Manager	Tanaka Kikinzoku Kogyo K.K.
Mary E. Wagner	Graduate Student	MIT
Masanori Matsumine	Administrative Staff	The University of Tokyo
Minoru Kawasaki	President	Nippon PGM AMERICA, INC.
Ng Kok Long	Graduate Student	The University of Tokyo
Osamu Takeda	Associate Professor	Tohoku University
Paul Burke		
Rebecca Miller		
Rina Yamada	Administrative Staff	The University of Tokyo
Ruofan Wang	Ph.D Candidate	Boston University
Ryohei Yagi	Graduate Student	The University of Tokyo
Sal Barriga		
Shun Ueda	Graduate Student	The University of Tokyo
Shunsuke Yagi	Associate Professor	The University of Tokyo
Sulata Kumari Sahu	Postdoctoral Researcher	MIT

Taiki Morishige	Associate Professor	Kansai University
Takanari Ouchi	Research Scientist	MIT
Tetsuya Uda	Professor	Kyoto University
Tetsuya Yamaki	Project Leader & Senior Principal Researcher	National Institutes for Quantum and Radiological Science and Technology
Thomas Villalón Jr.	Ph.D Candidate	Boston University
Toru H. Okabe	Professor	The University of Tokyo
Uday B. Pal	Professor	Boston University
Xiaofei Guan	Postdoctoral Fellow	Harvard University
Youyang Zhao	Ph.D Candidate	MIT
Yu Okabe	Undergraduate Student	Saitama University
Yu-ki Taninouchi	Research Associate	The University of Tokyo
Yuma Ninomiya	Graduate Student	The University of Tokyo