



# IMPI's

## 56<sup>TH</sup> ANNUAL MICROWAVE POWER SYMPOSIUM (IMPI 56)

June 14-16, 2022

**The DeSoto Hotel  
Savannah, Georgia, USA**

Register today at [www.IMPI.org](http://www.IMPI.org)



Presented by the  
International Microwave Power Institute

PO Box 1140, Mechanicsville, VA 23111 | Email: [info@impi.org](mailto:info@impi.org)

[www.impi.org](http://www.impi.org)



IMPI 56 is your opportunity to connect to and learn from the premier microwave power experts from around the world!

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## THE SYMPOSIUM

Join us and be part of the IMPI 56 experience: where knowledge is shared, networking is prolific, and the program offers topics for everyone interested in learning about the latest developments in microwave power science and technology. It's been three years since IMPI has brought together researchers, technologists and engineers from across the globe. We are delighted to welcome you back to our first in-person Symposium since 2019 to share the latest findings on microwave and radio frequency power systems for non-communication applications, including, plasma, chemical and material processing, solid-state, food processing, biological applications and more!

## HOST CITY, VENUE AND ACCOMMODATIONS

Savannah, Georgia is a coastal city best known for its southern hospitality, lively riverfront, and oak-lined streets. A top cultural destination in the Southeast, Savannah offers historical tours, unique museums, and many live music and theatre venues. The city center is only 9 miles from Savannah/Hilton Head International Airport. For those looking to couple their business trip with a vacation, Savannah is only 20 minutes from Tybee Island, GA and 45 minute drive from Hilton Head Island, SC.

Overlooking Madison Square in the heart of Savannah's Historic District, The DeSoto is a treasured landmark blending the elegance, history, and charm of one of America's oldest cities with a generous dash of modern Southern hospitality. The hotel's prime location in the residential historic district is just a short walk from the riverfronts touristy bustle. The DeSoto boasts 246 newly renovated guest rooms, a lovely pool, and on-site restaurants.

IMPI attendees may call the DeSoto Hotel to inquire about availability: 1-800-239-5118. Overflow hotel information will be provided shortly.

## SPECIAL EVENTS

There are several optional special events that registrants can add on during the registration process:

- [Workshop on Computer Modeling](#)
- [Solid State RF Energy Section Lunch & Presentation](#)
- [Group Dinner](#) at a Local Restaurant
- [Solid State RF Energy Section Business Meeting](#)
- Spouse/Guest Program

\*\*\*Times/days of presentations are subject to change\*\*\*

## TUESDAY, JUNE 14, 2022

- 8:00am - 3:30pm **WORKSHOP ON COMPUTER MODELING** *(Optional: additional fee applies)*
- 12:00pm - 1:30pm **LUNCH ON OWN**  
**SOLID-STATE RF ENERGY SECTION LUNCH** *(Optional: additional fee applies)*
- 3:30pm - 5:00pm **EXHIBITOR SHOWCASE**  
*Fifteen-minute presentations/demonstrations at exhibition booths.*
- Muegge GmbH (Germany)
  - Microwave Techniques (USA)
  - Leanfa (Italy)
  - Odyssey Technical Solutions (USA)
  - MKS (Italy)
  - Solid State RF Energy Section
  - QWED (Poland)
  - SAIREM (France)
  - Symphony Microwave (USA)
  - CrescendRF (USA)
  - Ampleon (Netherlands)
  - pinkRF (Netherlands)
  - WavePIA (Republic of Korea)
  - Richardson Electronics (USA)
  - 3DRFE Corporation (USA)
  - RFHIC (Republic of Korea)
- 5:00pm - 7:00pm **WELCOME RECEPTION** *(Posters and Exhibits Open)*  
*Hor d'oeuvres and cocktails in the Exhibit Hall*

## WEDNESDAY, JUNE 15, 2022

- 8:00am - 8:15am **WELCOME & INTRODUCTIONS**  
Vadim Yakovlev, Worcester Polytechnic Institute, Technical Program Committee Chair  
Candice Ellison, NETL/Leidos, Technical Program Committee Vice-Chair  
John F. Gerling, Gerling Consulting, Inc. & Interim President, IMPI
- PLENARY SESSION**  
Session Chair: Vadim Yakovlev, Worcester Polytechnic Institute, USA
- 8:15am - 9:00am **KEYNOTE ADDRESS: OVERVIEW OF RADIO FREQUENCY AND MICROWAVE DRIVEN PLASMA ION SOURCES FOR PARTICLE ACCELERATORS**  
Robert F. Welton<sup>1</sup>, Olli Tarvainen<sup>2</sup>, and Baoxi Han<sup>1</sup>  
<sup>1</sup>Spallation Neutron Source, Oak Ridge National Laboratory, Oak Ridge, TN, USA  
<sup>2</sup>UKRI-STFC-ISIS Pulsed Spallation Neutron and Muon Facility, Rutherford Appleton Laboratory, Harwell, UK
- 9:00am - 9:30am **INVITED: SOLID-STATE MICROWAVE POWER COMBINING TECHNIQUES**  
Zoya Popovic  
*University of Colorado, Boulder, CO, USA*

## WEDNESDAY, JUNE 15, 2022 CONTINUED

9:30am - 9:40am **POSTER FLASH SESSION**

9:40am - 9:45am **BREAK TO MOVE BETWEEN CONCURRENT SESSIONS**

9:45am - 10:55am **CONCURRENT SESSIONS**

### **SESSION A: MICROWAVE PLASMA I**

Session Chair: Raymond Boxman, Tel Aviv University, Israel

#### ***INVITED: Atmospheric Pressure Plasma Source and Downstream Source: Characteristics and Industrial Applications***

Robert Mueller<sup>1</sup>, Klaus-Martin Baumgaertner<sup>1</sup>, Markus Dingeldein<sup>1</sup>, Moritz Gorath<sup>1</sup>, Jens Hofmann<sup>1</sup>, Andreas Schulz<sup>2</sup>, and Matthias Walker<sup>2</sup>

<sup>1</sup>Muegge GmbH, Reichelsheim (Odenwald), Germany

<sup>2</sup>University of Stuttgart, Stuttgart, Germany

#### ***Tuning Method for Improved Microwave Power Coupling into Frequency Tuned Plasma and Enhanced Reliability of High-Power Coaxial Transmission Line***

Mohammad Kamarehi, Ilya Pokidov, Ken Trenholm, and Joe Desjardins

MKS Instruments / P&RGS, Wilmington, USA

#### ***Radiofrequency Plasma Heating for Electrodeless Space Thruster Applications***

Mario Merino, Jaime Navarro, Célian Boyé, Pedro Jiménez, Marco Inchingolo, Jiewei Zhou, and Eduardo Ahedo

Universidad Carlos III de Madrid, Leganés, Spain

### **SESSION B: COMPUTER MODELING I**

Session Chair: Marzena Olszewska-Placha, QWED, Poland

#### ***INVITED: Multiphysics Simulation of Flash Microwave Heating and Sintering***

Charles Maniere<sup>1</sup>, Geuntak Lee<sup>2,3</sup>, Shirley Chan<sup>2</sup>, Elisa Torresani<sup>2</sup>, Vadim V. Yakovlev<sup>4</sup>, John F. Gerling<sup>5</sup>, Eugene A. Olevsky<sup>2,3</sup>, Guillaume Riquet<sup>1</sup>, and Sylvain Marinel<sup>1</sup>

<sup>1</sup>Normandie Université, Caen, France

<sup>2</sup>San Diego State University, San Diego, CA, USA

<sup>3</sup>University of California, San Diego, La Jolla, CA, USA

<sup>4</sup>Worcester Polytechnic Institute, Worcester, MA, USA

<sup>5</sup>Gerling Consulting, Inc., Gilroy, CA, USA

#### ***Experimental and Computational Studies of Microwave Heating in Single-Stream Waste Processing***

Megan C. Robinson<sup>1</sup>, Vadim V. Yakovlev<sup>2</sup>, and Zoya Popovic<sup>1</sup>

<sup>1</sup>University of Colorado, Boulder, CO, USA

<sup>2</sup>Worcester Polytechnic Institute, Worcester, MA, USA

***Field Studies in Microwave Cavities: Magnetron vs. Solid-State RF Generator***

Xu Zhou, Zhongwei Tang, and Juming Tang  
Washington State University, Pullman, WA, USA

10:55am - 11:10am

**COFFEE BREAK**

11:10am - 12:20pm

**CONCURRENT SESSIONS**

**SESSION A: MICROWAVE PROCESSING OF MATERIALS**

Session Chair: Koen Van Reusel, Laborelec, Belgium

***INVITED: Microwave-Assisted Additive Manufacturing of Continuous Fiber Reinforced Thermoplastic Composites: Challenges and Opportunities***

Nanya Li, Guido Link, and John Jelonnek  
Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany

***SiCf/SiC Ceramic Matrix Composites Using Microwave Enhanced Chemical Vapour Infiltration***

Matthew T. Porter<sup>1</sup>, Andrea D'Angio, Jon Binner<sup>1</sup>, Vadim V. Yakovlev<sup>2</sup>, and Michael K. Cinibulk<sup>3</sup>

<sup>1</sup>University of Birmingham, Birmingham, UK

<sup>2</sup>Worcester Polytechnic Institute, Worcester, MA, USA

<sup>3</sup>Air Force Research Laboratory, Wright-Patterson Air Force Base, OH, USA

***NETL's Microwave-Material Interaction Studies***

Christina Wildfire<sup>1</sup>, Dushyant Shekhawat<sup>1</sup>, Candice Ellison<sup>2</sup>, Pranjali Muley<sup>2</sup>, and Biswanath Dutta<sup>2</sup>

<sup>1</sup>NETL, DOE, Morgantown, WV, USA

<sup>2</sup>Leidos, NETL, Morgantown, WV, USA

**SESSION B: COMPUTER MODELING II**

Session Chair: Louis Latrasse, SAIREM, France

***INVITED: FDTD Modeling of Microwave Power Applicators***

Bartłomiej W. Salski<sup>1</sup> and Marzena Olszewska-Placha<sup>2</sup>

<sup>1</sup>Warsaw University of Technology, Warsaw, Poland

<sup>2</sup>QWED Sp. z o.o., Warsaw, Poland

***On the Multiphysics Modelling of Chemical Processes with Solid-State Driven Microwave Systems***

Pablo Santón<sup>1</sup>, Elías De los Reyes<sup>1</sup>, Ruth De los Reyes<sup>2</sup>, J. Vicente Balbastre<sup>1</sup>, and José Vicente Ros<sup>3</sup>

<sup>1</sup>Polytechnic University of Valencia, Valencia, Spain

<sup>2</sup>Microbiotech S.L., Vilamarxant, Spain

<sup>3</sup>University of Valencia, Valencia, Spain



## WEDNESDAY, JUNE 15, 2022 CONTINUED

### ***AI-Based Prediction of Microwave Effects on Ore Preconditioning and Breakage***

Khashayar Teimoori<sup>1,2</sup>, Brent Hilscher<sup>1</sup>, Candice Ellison<sup>3,4</sup>, and Dushyant Shekhawat<sup>3</sup>

<sup>1</sup>ABH Engineering Inc., Surrey, BC, Canada

<sup>2</sup>McGill University, Montreal, QC, Canada

<sup>3</sup>National Energy Technology Lab, Morgantown, WV, USA

<sup>4</sup>NETL Research Support Contractor, Morgantown, WV, USA

12:10pm - 1:05pm

**NETWORKING LUNCHEON** (Posters & Exhibits Open)

1:05pm - 2:05pm

**POSTER & EXHIBITOR SESSION**

2:05pm - 2:20pm

**SPECIAL PRESENTATION: AMPERE 2023**

Daniel R. Slocombe, Cardiff University, UK

2:20pm - 3:00pm

**CONCURRENT SESSIONS**

### **SESSION A: DIELECTRIC PROPERTIES & MATERIALS**

Session Chair: Sean McKeown, Graphic Packaging International, USA

### ***Use of Dielectric Properties Measurements for Monitoring Water Activity Changes in Almonds***

Samir Trabelsi

U.S. National Poultry Research Center, USDA-ARS, Athens, GA, USA

### ***The Effects of Different Microwave Powers and Frequencies on the Reduction of Magnetite to Iron***

Morgan Chen<sup>1</sup>, Shuyan Zhang<sup>1</sup>, Victor Abdelsayed<sup>2</sup>, Daniel Haynes<sup>2</sup>, and

B. Reeja Jayan<sup>1</sup>

<sup>1</sup>Carnegie Mellon University, Pittsburgh, PA, USA

<sup>2</sup>National Energy Technology Lab, Morgantown, WV, USA

### **SESSION B: CHEMISTRY & PLASMA I**

Session Chair: John F. Gerling, Gerling Consulting, USA

### ***Mass Separation by the Ponderomotive Force Exerted by Standing Alfvén Waves***

Amnon Fruchtman and Gennady Makrinich

Holon Institute of Technology, Holon, Israel

### ***Material/Chemical Recycling via CO<sub>2</sub>-Free Emissions by Using Microwave Flash Pyrolysis of Waste Plastics***

Anna Sawai and Satoshi Horikoshi

Sophia University, Chiyoda-ku, Tokyo, Japan

3:00pm - 3:15pm

**COFFEE BREAK**

3:15pm - 4:15pm

## CONCURRENT SESSIONS

### SESSION A: SOLID-STATE TECHNOLOGIES

Session Chair: Klaus Werner, pinkRF, The Netherlands

#### ***Modular and Scalable Solid-State Architectures for Frequency-Dependent Microwave Processes***

Marco Fiore, Nicola Di Modugno, Tommaso De Nicolo, and Cristian Bruno  
LEANFA Srl, Ruvo di Puglia, Italy

#### ***Solid-State Technologies LDMOS and GaN Compared***

Patrick Valk and Coen Centen  
Ampleon, Nijmegen, Netherlands

#### ***MML, Solid-State Oven Interoperability and The Meta Verse***

Steven Drucker  
Droaster Laboratories LLC, Greer, SC, USA

### SESSION B: MICROWAVE CHEMISTRY & PLASMA II

Session Chair: Mohammad Kamarehi, MKS Instruments, USA

#### ***A Miniature Electron Cyclotron Resonance Ion Source for Neutron Generators***

David L. Williams, Allan X. Chen, Craig Brown, Adam Amoroso, Veronica Smith, Mashal Elsalim, and Charles K. Gary  
Adelphi Technology, Inc., Redwood City, California, USA

#### ***The Influence of Post-Plasma Species from Microwave Enhanced CH<sub>4</sub>/N<sub>2</sub>/Ar Plasma on the Selectivity of Ethylene and Ammonia***

Sarojini Tiwari, Brandon Robinson, Sean Brown, Jianli Hu, and Sonit Balyan  
West Virginia University, Morgantown, WV, USA

#### ***Microwave Plasma Conversion of Natural Gas for Hydrogen and Carbon Production***

Alvaro Martin Ortega<sup>1</sup>, Gérard Gatt<sup>1</sup>, Arnaud Boutibonnes<sup>2</sup>, Ariel Mello<sup>3</sup>,  
Marilena Radoiu<sup>3</sup>

<sup>1</sup>Sakowin SAS, Fréjus, France

<sup>2</sup>Polytech de Marseille, Marseille, France

<sup>3</sup>Microwave Technologies Consulting SAS, Lyon, France

4:15pm- 5:00pm

## PANEL: SOLID-STATE RF ENERGY

5:00pm - 5:40pm

**IMPI BUSINESS MEETING** (Open to all current and potential IMPI members)  
Unveiling of the Bob Schiffmann Leadership Award & Scholarship

6:45pm-9:00pm

**GROUP DINNER AT LOCAL RESTAURANT** (Optional: additional fee applies)

## THURSDAY, JUNE 16, 2022

8:00am-8:05am

### ANNOUNCEMENTS

### PLENARY SESSION

Session Chair: Candice Ellison, NETL/Leidos, USA

8:05am - 8:50am

### KEYNOTE ADDRESS

#### ***Path Toward Multi-Megawatt Microwave Reactors for the Production of Low Carbon Hydrogen***

Jan H.D. Boshoff and James M. Tranquilla

Nu:ionic Technologies (Canada) Inc., Fredericton, NB, Canada

8:50am - 9:20am

#### ***INVITED: Operational Experience with 1 MHz, 200 kW Free Running Oscillators for the ITER NBI RF Plasma Source***

Alberto Maistrello

Consorzio RFX, Università di Padova, Acciaierie Venete SpA, Padova, Italy

9:20am - 9:25am

### BREAK TO MOVE BETWEEN CONCURRENT SESSIONS

9:25am - 10:55am

### CONCURRENT SESSIONS

#### SESSION A: MICROWAVE CHEMISTRY I

Session Chair: Daniel Slocombe, Cardiff University, UK

#### ***INVITED: Selective Microwave Heating of Organic Reaction Mixtures***

Gregory B. Dudley

West Virginia University, Morgantown, WV, USA

#### ***Effect of Microwave-Assisted Gasification on the Chemical and Physical Properties of Coal Chars***

Candice Ellison<sup>1,2</sup>, Victor Abdelsayed<sup>1,2</sup>, Mark Smith<sup>1</sup>, and Dushyant Shekhawat<sup>1</sup>

<sup>1</sup>National Energy Technology Laboratory, Morgantown, WV, USA

<sup>2</sup>NETL Research Support Contractor, Morgantown, WV, USA

#### ***Microwave-Assisted Ammonia Synthesis Over Cs-Ru/CeO<sub>2</sub> Catalyst at Ambient Pressure: Effects of Metal Loading and Support Particle Size***

Alazar Araia<sup>1</sup>, Yuxin Wang<sup>1</sup>, Brandon Robinson<sup>1</sup>, Changle Jiang<sup>1</sup>, Christina Wildfire<sup>2</sup>, Dushyant Shekhawat<sup>2</sup>, and Jianli Hu<sup>1</sup>

<sup>1</sup>West Virginia University, Morgantown, WV, USA

<sup>2</sup>National Energy Technology Laboratory, Morgantown, WV, USA

#### ***Chemical Looping Ammonia Synthesis: Microwave and Thermal Fixed Bed Systems***

Sean W. Brown<sup>1</sup>, Candice Ellison<sup>2</sup>, Dushyant Shekhawat<sup>2</sup>, and Jianli Hu<sup>1</sup>

<sup>1</sup>West Virginia University, Morgantown, WV, USA

<sup>2</sup>National Energy Technology Laboratory, Morgantown, WV, USA



## SESSION B: INDUSTRIAL MICROWAVES

Session Chair: Ralph Bruce, Vanderbilt University, USA

### ***INVITED: New World of Internet-of-Energy with Wireless Power Transfer via Microwaves***

Naoki Shinohara

Kyoto University, Kyoto, Japan

### ***Microwave Drying of Lithium Oxides for Battery Manufacturing***

Kenneth Kaplan

Cellencor, Inc., Ankeny, IA, USA

### ***Control of Phase Offset Between Coherent Microwave Sources for Industrial Applications***

John F. Gerling

Gerling Consulting, Inc., Gilroy, CA, USA

### ***Improved Manufacturing Through Continuous High Temperature Microwave Process: The DESTINY Project***

Koen Van Reusel<sup>13\*</sup>, Dimitrios Giannopoulos<sup>1</sup>, Luis Guaita<sup>2</sup>, Angel Lopez<sup>3</sup>, Paolo Chiariotti<sup>4</sup>, Beatriz Garcia<sup>5</sup>, Ana Felis<sup>6</sup>, Oscar Centelles<sup>7</sup>, Kersten Marx<sup>8</sup>, Lukas Schmidt<sup>9</sup>, Kerstin Walter<sup>10</sup>, Ana Santos<sup>11</sup>, Marco Molica Colella<sup>12</sup>, Jose Fernandes Pereira<sup>14</sup>

<sup>1</sup>National Technical University of Athens, Greece

<sup>2</sup>Keraben Grupo SA, Spain,

<sup>3</sup>Innceinnmat SL, Spain,

<sup>4</sup>Universita Politecnica delle Marche, Italy,

<sup>5</sup>Universitat Politecnica de Valencia, Spain

<sup>6</sup>Al-Farben S.A, Spain

<sup>7</sup>Chumillas Technology, Spain

<sup>8</sup>VDEh-Betriebsforschungsinstitut GmbH, Germany

<sup>9</sup>K1-MET GmbH, Austria

<sup>10</sup>DK Recycling und Roheisen GmbH, Germany

<sup>11</sup>Cemex Research Group AG, Switzerland,

<sup>12</sup>Ciaotech Srl, Italy

<sup>13</sup>Belgisch Laboratorium van de Elektriciteitsindustrie – Laborelec, Belgium

<sup>14</sup>Instituto Superior Tecnico, Portugal

10:55am - 11:10am

## COFFEE BREAK

## THURSDAY, JUNE 16, 2022 CONTINUED

11:10am - 12:30pm

### CONCURRENT SESSIONS

#### SESSION A: MICROWAVES IN FOOD ENGINEERING

Session Chair: Ulrich Erle, Nestle R&D, USA

##### ***A Dry, Flexible, Modular and Digital Microwave System for Pasteurization at Atmospheric Pressure***

Klaus M. Baumgaertner, Markus Dingeldein, Guido Kassel, Tom Georgi, Markus Reichmann, Daniel Baars, Parth Patel, Moritz Gorath, and Robert Mueller Muegge GmbH, Reichelsheim (Odenwald), Germany

##### ***Development of Solid-State Microwave Defrosting Strategies with Adaptive Power and Shifting Frequency***

Ran Yang and Jiajia Chen\*

University of Tennessee, Knoxville, TN, USA

##### ***Product-Friendly Heating and Drying of Model Food Using a Solid-State Microwave Generator***

Isabel Kalinke and Ulrich Kulozik

Technical University Munich, Munich, Germany

##### ***Electric Heating Technologies: Ohmic and Microwave Heating, Comparison of Industrial Applications***

Pablo M Coronel<sup>1</sup>, Josip Simunovic<sup>2</sup>

<sup>1</sup>CRB Consulting Engineers, Cary, NC

<sup>2</sup>North Carolina State University, Raleigh, NC

#### SESSION B: BIOLOGICAL APPLICATIONS

Session Chair: Steven Drucker, Droaster Laboratories LLC, USA

##### ***Microwave Soil Heating Promotes Strawberry Runner Production and Progeny Performance***

Graham I. Brodie<sup>1</sup>, Dylan J. McFarlane<sup>2</sup>, Muhammed J. Khan<sup>1</sup>, Valerie B.G. Phung<sup>1</sup>, and Scott W. Mattner<sup>2</sup>

<sup>1</sup>The University of Melbourne, Dookie, Australia

<sup>2</sup>VSICA Research and La Trobe University, Melbourne, Australia

##### ***Effect of Microwave Treatment of Soil in a Metal Planter on Crop Yield***

Raymond L. Boxman<sup>1,2</sup> and Amogh Panchagatti<sup>1</sup>

<sup>1</sup>Tel Aviv University, Tel Aviv, Israel

<sup>2</sup>Clear Wave Ltd, Herzliya, Israel

##### ***Microwaves as the Optimal Tool for Microbiological Decontamination of Air and Surfaces***

Iurie A. Bosneaga

Institute of Applied Physics, Chisinau, Republic of Moldova

## THURSDAY, JUNE 16, 2022 CONTINUED

12:30pm - 1:05pm **NETWORKING LUNCHEON** (*Posters and Exhibits Open*)

1:05pm - 2:05pm **POSTER & EXHIBITOR SESSION**

2:05pm - 2:20pm **SPECIAL PRESENTATION: UIE 2024**

Koen Van Reusel, *Laborelec, Belgium*

2:20pm - 3:20pm **MICROWAVE CHEMISTRY II**

Session Chair: Gregory Dudley, *West Virginia University, USA*

### ***Effective Microwave Heating of Catalysts: Comparison of Electric and Magnetic Fields***

Daniel R. Slocombe<sup>1</sup>, Alex J. L. Morgan<sup>1</sup>, Xiangyu Jie<sup>2</sup>, and Peter P. Edwards<sup>2</sup>

<sup>1</sup>*Cardiff University, Cardiff, UK*

<sup>2</sup>*University of Oxford, Oxford, UK*

### ***Microwave Catalytic Non-Oxidative Conversion of a Model Natural Gas to Hydrogen and Carbon Nanotubes***

Changle Jiang, Sonit Balyan, Brandon Robinson, Alazar Araia, Yuxin Wang, and Jianli Hu  
*West Virginia University, Morgantown, WV, USA*

### ***Microwave-Enhancement Conversion of Methane into Aromatics Over Mo/ZSM-5 Catalysts***

Victor Abdelsayed<sup>1,2</sup>, Ashraf Abedin<sup>1,2</sup>, Pranjali D. Muley<sup>1,2</sup>, Hari P. Paudel<sup>1,2</sup>, and Daniel J. Haynes<sup>1</sup>

<sup>1</sup>*National Energy Technology Laboratory, Morgantown, WV, USA*

<sup>2</sup>*NETL Research Support Contractor, Morgantown, WV, USA*

3:20pm - 3:30pm **AWARDS & CLOSING REMARKS**

***Multifrequency Dielectric Properties Measurement Method Based on Coplanar Waveguide***

Pablo Santón<sup>1</sup>, J. Vicente Balbastre<sup>2</sup>, Mariano Baquero<sup>2</sup>, Ruth De los Reyes<sup>1</sup>, and Elías De los Reyes<sup>2</sup>

<sup>1</sup>Microbiotech S.L., Vilamarxant, Spain

<sup>2</sup>Polytechnic University of Valencia, Valencia, Spain

***Microwave-Assisted Frying and Post-Frying of French Fries***

Xu Zhou, Zhongwei Tang, and Juming Tang

Washington State University, Pullman, WA, USA

***The MATS Process Validation***

Moses A. Magana

915 Labs, Denver, CO, USA

***Characterizing the Effect of Oven Geometry on the Modeling Accuracy of Microwave Heating***

Kartik Verma, Hao Gan, and Jiajia Chen<sup>1</sup>

University of Tennessee, Knoxville, TN, USA

**Solid-State RF Energy Section Business Meeting**

Friday, June 17th from 9am-11am.

All are welcome. RSVP to [alicia.standridge@impi.org](mailto:alicia.standridge@impi.org)



**Dr. Robert Welton**

Senior Scientist, Oak Ridge National Laboratory, USA

***"Overview of radio frequency and microwave driven plasma ion sources for particle accelerators"***

Particle accelerators are among the most important scientific tools of the modern era. Many of the large hadron facilities employ accelerator complexes which include cyclotrons, synchrotrons, storage rings, linear or tandem accelerators and deliver ion beams of very high-intensity and/or very high-energy to their user facilities. These accelerator complexes require the injection of positive or negative ions of varying charge states which are produced in bright ion sources where ions are typically formed within a plasma. Increasingly, RF and microwave systems are being utilized, to generate these ion-rich plasmas due to their high reliability, minimal use of consumable components, and ability to access very high charge states. This keynote address discusses the basic mechanisms of ion formation and plasma generation as well as some specifics of RF/microwave generators, matching circuits and plasma coupling structures. The ever-growing demands of microwave systems for electron cyclotron resonance ion sources, operating at frequencies from 2.45 GHz to 75 GHz, for nuclear physics research and applications are also outlined.



**Dr. Jan Boshoff**

Co-founder and CEO, Nu:ionic Technologies Inc, Canada

***"Multi-megawatt industrial microwave systems for the production of low carbon hydrogen and other process applications"***

Nu:ionic Technologies' Teal Hydrogen production technology is a unique cost-effective low carbon hydrogen production technology at distributed scale. The innovative use of industrial microwave technology in its large scale catalytic reformer reactors reduces fossil fuel demand by 30% and is significantly more compact than conventional gas reformers. This presentation provides an overview of the technology and multi-disciplinary approach to scale-up on its pathway to realize multi-megawatt gas conversion reactors.



## INVITED SPEAKERS



**Dr. Gregory Dudley**

*Eberly Family Distinguished  
Professor, West Virginia  
University, USA*



**Dr. Guido Link**

*Head of Materials-Processing  
with Microwaves, Institute for  
Pulsed Power and Microwave  
Technology, Karlsruhe  
Institute of Technology,  
Germany*



**Dr. Alberto Maistrello**

*Researcher, Consorzio RFX,  
Italy*



**Dr. Charles Manière**

*Chargé de Recherche, CNRS-  
CRISMAT Laboratory, France*



**Dr. Robert Mueller**

*General Manager, Muegge  
GmbH, USA*



**Dr. Zoya Popovic**

*Distinguished Professor,  
Lockheed Martin Endowed  
Chair in RF Engineering,  
University of Colorado,  
Boulder, USA*



**Dr. Bartłomiej Salski**

*Professor, Warsaw University  
of Technology, Poland*



**Dr. Naoki Shinohara**

*Professor, Kyoto University,  
Japan*

**Special thanks to the IMPI 56 Technical Program Committee for their dedication to this Symposium:**

**Chairs**

Vadim Yakovlev, Worcester Polytechnic Institute, USA, Chair

Candice Ellison, National Energy Technology Laboratory, USA, Vice-Chair

**Organizers of Special Sessions**

Raymond Boxman, Tel Aviv University, Israel

Ulrich Erle, Nestle R&D, USA

Marzena Olszewska-Placha, QWED, Poland

Marilena Radoiu, Microwave Technologies Consulting, France

**Members**

Eleanor Binner, University of Nottingham, UK

Graham Brodie, University of Melbourne, Australia

John F. Gerling, Gerling Consulting, Inc., USA

Satoshi Horikoshi, Sophia University, Japan

B. Reeja Jayan, Carnegie Mellon University, USA

Yang Jiao, Shanghai Ocean University, China

Birgitta Raaholt, Research Institute of Sweden, Sweden

Klaus Werner, pinkRF B.V., Netherlands

## REGISTRATION

**Please mail this completed form with payment to:**  
International Microwave Power Institute  
PO Box 1140, Mechanicsville, VA 23111  
Or register online at [www.IMPI.org](http://www.IMPI.org)

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State/Prov.: \_\_\_\_\_ Postal Code: \_\_\_\_\_

Country: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_

### SYMPOSIUM (Circle one)

	Regular Registration
Professional/Corporate IMPI Member	\$750
Professional Non-Member	\$850
Student IMPI Member	\$475
Student Non-Member	\$525

**Registration Fee Includes:** Attendance at all in-person sessions from Tuesday, June 14, 2022 at 3:30pm until Thursday, June 16th at 3:45pm, Welcome Reception, two continental breakfasts, four coffee breaks, two networking luncheons, exhibition hall access, online access and printed copy of the conference Proceedings.

### ADD-ONS (Optional)

#### Workshop on Computer Modeling:

- ☐ IMPI Member: \$299   ☐ Non-Member: \$349  
☐ Solid State RF Energy Luncheon: \$50  
☐ Group Dinner at local restaurant: \$50

### MEMBERSHIP

Not a member? Join IMPI now and save significantly on registration:

- ☐ Professional Membership: \$220  
☐ Student Membership (Valid Student ID required): \$50  
☐ Corporate Membership: \$2,500

Registration fee: \$ \_\_\_\_\_

Add-ons: \$ \_\_\_\_\_

Membership fee: \$ \_\_\_\_\_

**TOTAL DUE:** \$ \_\_\_\_\_

### PAYMENT

- ☐ Check enclosed (Make check payable to IMPI)

- ☐ Credit card payment:   ☐ Visa   ☐ Mastercard   ☐ Discover   ☐ AMEX

Charge amount: \$ \_\_\_\_\_ Card Number: \_\_\_\_\_

Exp. Date: \_\_\_\_\_ Security Code: \_\_\_\_\_ Name of Cardholder: \_\_\_\_\_

Billing Address (if different from above): \_\_\_\_\_

Signature: \_\_\_\_\_

*Microwave power researchers and experts—in one place, at one time.*

## IMPI 56 SPONSORS

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Group Dinner



VIP Reception

## IMPI 56 EXHIBITORS



**AMPLEON**



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Microwave Technologies



**pinkRF**





**HEALTH & SAFETY PROTOCOLS:** IMPI is committed to offering an in-person IMPI 56 Symposium in June of 2022 in Savannah, Georgia, USA. We continue to closely monitor COVID developments, and will implement policies and best practices according to CDC guidance to ensure the health and safety of our attendees, based on the conditions at the time of the event. This may include: proof of vaccination, a negative COVID test and/or an indoor masking requirement. Real-time updates from the City of Savannah are [available here](#). Updated guidance will be issued [here](#), as warranted.



REGISTER TODAY AT [WWW.IMPI.ORG](http://WWW.IMPI.ORG) | SEE YOU IN GEORGIA!

**Questions or Comments?**  
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