

## **Report on the "High-Power Microwave Industrial Applications" Workshop at the European Microwave Week 2020**

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The main forum of the European microwave community at-large, the European Microwave Week 2020 (EuMW2020) ([www.eumweek.com/](http://www.eumweek.com/)) was scheduled to take place in September 2020 in Utrecht, The Netherlands. Because of the global pandemic, it was held in a virtual format on 10-15 January 2021. For the first time in the European Microwave Week series that started in 1969, the 2020 forum featured a special event focused on microwave high-energy technologies. The Workshop "High-Power Microwave Industrial Applications" was proposed to the EuMW2020 and organized by Zoya Popovic of the University of Colorado at Boulder and Vadim Yakovlev of Worcester Polytechnic Institute.

This event had a historic predecessor. A dedicated Workshop on the same topic took place more than a decade ago at the IEEE MTT International Microwave Symposium (IMS) in Boston in 2009. Not only did that Workshop win the "Best Quality Workshop" Award, but it became an inauguration forum that introduced the MTT community to microwave energy applications in science and industry. After the Boston Workshop, since 2010, high power microwave technologies and the related microwave non-communication and radar topics have been included in the list of main IMS Technical Areas, and that opened the door for annual submission of dozens of papers and formation of dedicated sessions in the IMS programs. For the last several years, topics in microwave power

technologies have notably widened in scope and deepened in depth, so one of the goals of the organizers was to expose the major European gathering of microwave scientists and engineers to the recent developments in the field, as well as to new trends and emerging applications. Accordingly, another goal was to extend the network of the members of the EuMW community to the AMPERE Association and its activities, in particular, to its upcoming 18<sup>th</sup> Conference in Gothenburg in September 2021.

The program of the 2020 EuMW Workshop was a balanced combination of contributions from academia and industry. For the latter, Jens Hofmann of MUEGGE GmbH talked on high power industrial applications and market trends. A presentation by Kostyantyn Achkasov currently affiliated with Advanced Materials was focused on a microwave-induced plasma in a wide array of both academic and industrial applications. Marilena Radoiu of Microwave Technologies Consulting spoke on the challenge of scaling up microwave-assisted technologies. Development of solid-state technology and its impact on microwave power engineering were analyzed by Klaus Werner of pink RF. From academia, Bala Vaidhyanathan of Loughborough University talked about field-assisted manufacturing of materials. Microwave-assisted metallurgy using hybrid systems were reviewed by Paolo Veronesi of University of Modena and Reggio Emilia. Zoya Popovic presented principles and practice of high

power in-cavity SSPA combining. A review of modern options in advanced multiphysics simulation of microwave power processes and systems was given by Vadim Yakovlev. A presentation by José Catalá-Civera of Polytechnic University of Valencia was focused on measurement of temperature-dependent complex permittivity of materials, and in-situ monitoring of high-power microwave material processing was in the center of the talk given by Sébastien Vaucher of EMPA. The fact that four speakers of the EuMW2020 Workshop, Jose Catalá-Civera, Sébastien Vaucher, Paolo Veronesi, and Vadim Yakovlev, were also the presenters at the 2009 IMS Workshop in Boston suggests indeed a meaningful historical parallel of the two events.

Organizers of the first virtual European Microwave Week report that while the number of registrations exclusively for the Workshop was 13, the number of views of its different video presentations was much higher and reached maximum at 34.

For more info about the EuMW2020 Workshop "High-Power Microwave Industrial Applications" please contact its organizers Zoya Popovic ([zoya.popovic@colorado.edu](mailto:zoya.popovic@colorado.edu)) and Vadim Yakovlev ([vadim@wpi.edu](mailto:vadim@wpi.edu)) as well as the EuMW2020 Workshop Chair, Laura Anitori ([workshops@eumw2020.org](mailto:workshops@eumw2020.org)).

### About the author



**Vadim Yakovlev** is an Associate Research Professor in the Department of Mathematical Sciences, Worcester Polytechnic Institute (WPI), Worcester, MA, USA. He is a head of the Industrial Microwave Modeling Group, which he formed in 1999 as a division of the WPI's Center for Industrial Mathematics

and Statistics. Dr. Yakovlev received his Ph.D. degree in Radio Physics from the Institute of Radio Engineering and Electronics of the Russian Academy of Sciences, Moscow, Russia in 1991. His current research interests include multiphysics modeling, microwave power engineering, microwave imaging, and machine-learning optimization. He has authored nearly 200 papers in journals and conference proceedings. Funding for his research came from the US NSF, US DOE, AFRL, AFOSR, and EADS (currently Airbus Group). Dr. Yakovlev is a Fellow of International Microwave Power Institute (IMPI), a Senior Member of IEEE, a member of AMPERE. From 2010 to 2020, he was a member and Subcommittee Chair of the IEEE MTT-S International Microwave Symposium's Technical Paper Review Committee. In 2013, he served as Chair of the Technical Program Committee for the 47th IMPI Microwave Power Symposium. He is the Founder of a series of international interdisciplinary seminars, Computer Modeling in Microwave Power Engineering held annually from 2000 to 2017. In 2007, he was a Guest Editor for the Special Issue on Modeling in Microwave Power Engineering of the Journal of Microwave Power and Electromagnetic Energy.