



**SP**lab



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# 14th International Workshop on Combustion and Propulsion (IWCP)

**Micro- and Nano-Sized Advanced  
Energetic Materials for Propulsion  
and Energetic Applications**

## TECHNICAL PROGRAM TIMELINE (Only speakers are indicated)



28 - 31 July 2024

0840-1920



**Venue: Aurum, Largo  
Gardone Riviera, 65126  
Pescara, PE, Italy.**

Monday 29 July 2024

## 0 - Workshop Opening

Co-chairs: Luigi T. DeLuca and Ruth M. Doherty



0840-0850

**Luigi T. DeLuca**, Workshop Chair, Dept. of Aerospace Science and Technology, Politecnico di Milano (Ret.), Milan, Italy  
**Ruth M. Doherty**, Workshop Chair, Energetics Technology Center, Indian Head, MD, USA

## 01 - Novel Energetic Materials and Concepts

Co-chairs: Ruth M. Doherty and Zois Boukouvalas



0850-0930

### Opening of the Workshop

**Ruiqi Shen**, Nanjing University of Science and Technology, China  
**Smart energetic materials**



0930-0950

### Plenary Lecture

**Victor Abrukov**, Chuvash State University, Cheboksary, Russia  
**Neural networks in solving direct and inverse problems of the experiment on the development of novel micro- and nano-sized advanced energetic materials**



0950-1010

**Raphaël Terreux**, ECMo team/Laboratoire de Biologie Tissulaire et d'Ingénierie (LBTI) - UMR 5305 CNRS UCBL, Lyon, France  
**In silico mutagenicity prediction by similarity search and machine learning algorithm: Prediction, reliability index and mapping for high energetic materials**



1010-1030

**Steven F. Son**, School of Mechanical Engineering, Purdue University, West Lafayette, IN, USA  
**Multifunctional energetic materials**



1030-1050

**Edward L. Dreizin**, New Jersey Institute of Technology, Newark, NJ, USA  
**Reactive composite powders prepared by emulsion-assisted milling**



1050-1120

**Coffee/Tea Break Sala Pazienza**



1120-1140

**V. Weiser**, Fraunhofer Institut für Chemische Technologie ICT, Pfinztal, Germany  
**Investigation on the combustion of silicon as a carbon-free energy carrier to be used as fuel for ship propulsion and for heat and power generation**

## 02 – Solid Rocket Propulsion: Motor Performance

Co-chairs: Alexander B. Vorozhtsov and Evgeny Shafirovich



1140-1200

**F. Maggi**, Dept. of Aerospace Science and Technology, Politecnico di Milano, Milan, Italy  
**Additive manufacturing in solid propulsion charges**



1200-1220

**Sebastian K. Hampl**, McGill University, Quebec, Canada  
**Conceptual design of rocket engines using regolith-derived propellants**



1220-1240

**Hijlkema Jouke**, The Propulsion Laboratory of ONERA, France  
**On the in-situ optical particle size distribution measurements in a new installation that reduces inherent bias**



1240-1300

**Adriano Annovazzi and Emanuela Gizzi**, Avio S.p.A., Colleferro, Italy  
**A model of burn rate scaling for solid rocket motor performance prediction**



1300-1430

**Lunch Break Lido La Playa**

## 03 – Solid Rocket Propulsion: Propellant Combustion

Co-chairs: Helmut Ciezki and RongJie Yang



1430-1450

**RongJie Yang**, Beijing Institute of Technology, China  
**Combustion characteristics of composite solid propellants added with polyhedral oligomeric phenyl silsesquioxanes**



1450-1510

**Jianbing Xu**, Nanjing University of Science and Technology, China  
**Amidoxime-functionalized covalent organic framework for enhanced thermal decomposition of ammonium perchlorate**



1510-1530

**Yan Hu**, Nanjing University of Science and Technology, China  
**CuI encapsulated within single-walled carbon nanotubes as catalysts for combustion of CL-20**



1530-1600

**Coffee/Tea Break Sala Pazienza**

# 04 - Solid Rocket Propulsion: Burning Rate

Co-chairs: Edward L. Dreizin and RuiQi Shen



1600-1620

**Suhang Chen**, Northwest University, China

**The thermal expansion and contraction of AP-rich particles achieve the low burning rate temperature coefficient of composite propellants**

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1620-1640

**Wei Zhang**, Nanjing University of Science and Technology, China

**Research progress in electrically controlled solid propulsion**

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1640-1810

**Roundtable RTI chaired by Ruth M. Doherty, ETC, Indian Head, MD, USA**

**Application of artificial intelligence and machine learning to novel energetic materials**

**Panel of Experts:** Victor Abruikov, Russia; Zois Boukouvalas, USA; Raphaël Terreux, France; Stephen S. Baek, USA.

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1810-1820

**Closure of the 1st day**

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Tuesday 30 July 2024

0840-0850

## Announcements

# 05 – Metals in Combustion and Propulsion

Co-chairs: Viktor S. Abrukov and DaoLun Liang



0850-0930

## Plenary Lecture

**Evgeny Shafirovich**, The University of Texas at El Paso, TX, USA  
**Combustion of metals for power generation on earth and beyond**



0930-0950

**Alain Brillard**, Laboratory of Risk Management and Environment, University of Upper-Alsace, France  
**High-temperature oxidation of metal particles in a fluidized bed reactor**



0950-1010

**Jinxian Zhai**, Beijing Institute of Technology, Beijing, China  
**Micro-sized aluminum ammonium dinitramide core-shell particles to improve the combustion performances of aluminum and solid propellant**



1010-1030

**Fabien Halter**, Université d'Orléans, ICARE-CNRS, Orléans, France  
**Detailed description of the combustion of an aluminum particle**



1030-1050

**Mirko Schoenitz**, New Jersey Institute of Technology, Newark, NJ, USA  
**Reactive spherical composite powders of boron and polytetrafluoroethylene (PTFE)**



1050-1120

**Coffee/Tea Break Sala Pazienza**

# 06 – Nanomaterials for Propulsion and Energetic Applications

Co-chairs: Thomas M. Klapötke and Steven F. Son



1120-1140

**Alexander B. Vorozhtsov**, Laboratory for High Energy and Special Materials, National Research Tomsk State University, Tomsk, Russia  
**High energy and special nanomaterials**



1140-1200

**WeiQiang Pang**, Xi'an Modern Chemistry Research Institute, China  
**Effect of nano-sized energetic materials (nEMs) on the performance of solid rocket propellants: A brief review**



1200-1220

**Daolun Liang**, Key Laboratory of Energy Thermal Conversion and Control of Ministry of Education, Southeast University, Nanjing, China  
**Evaporative combustion characteristics of ultrasonically levitated single nAl-based slurry droplets with various liquid oxygenated fuels and solid concentrations**



1220-1240

**Helmut K. Ciezki**, Consultant of PEHC, Neckarsulm, Germany  
**Some aspects of properties of particle containing gel propellants in relation to propulsion applications**



1240-1300

**Yihua Ren**, University of Chinese Academy of Science, Beijing, China  
**In-situ laser diagnostics of nanoparticles, combustion and propulsion based on conventional and phase-selective laser-induced breakdown spectroscopy**



1300-1430

**Lunch Break Lido La Playa**

## 07- Poster Session I

Co-chairs: Luciano Galfetti and WeiQiang Pang



1430-1530

**Introduction and Free Discussion**



1530-1600

**Coffee/Tea Break Sala Pazienza**

## 08 – Poster Session II

Co-chairs: Luciano Galfetti and WeiQiang Pang



1600-1640

**Free Discussion**



1640-1810

**Roundtable RT2 chaired by Volker Weiser, ICT, Pfinztal, Germany**

**Metal combustion for propulsion and energetic applications**  
**Panel of Experts:** Helmut Ciezki, Germany; Edward Dreizin, USA; Alexander B. Vorozhtsov, Russia.



1810-1820

**Closure of the 2nd day**

Wednesday 31 July 2024

0840-0850

**Announcements**

## 09 – Sensitivity

Co-chairs: Michael Gozin and Qi-Long Yan



0850-0930

**Plenary Lecture**

**Svatopluk Zeman**, Institute of Energetic Materials, Faculty of Chemical Technology, University of Pardubice, Pardubice, Czechia  
**Insights towards the impact sensitivity of cyclic nitramines**



0930-0950

**Stephen S. Baek**, Department of Mechanical and Aerospace Engineering, University of Virginia, VA, USA  
**Physics-aware recurrent convolutional neural networks for modeling hotspot formation and growth in energetic materials**



0950-1010

**Abhishek Kumar Yadav**, Energetic Materials Laboratory, Department of Chemistry, Indian Institute of Technology Kanpur, India  
**Synthesis of advanced pyrazole and n-n-bridged bistriazole-based secondary high-energy materials**



1010-1030

**Qi-Long Yan**, Northwestern Polytechnical University, Xi'an, China  
**Study on thermal decomposition and stabilization mechanisms of hybrid nitramine crystals**



1030-1050

**Yinghua Ye**, Nanjing University of Science and Technology, China  
**Study on the explosion process of semiconductor bridge under capacitor discharge**



1050-1120

**Coffee/Tea Break Sala Pazienza**

## 10 – Advanced Computational Techniques for Modeling and Simulation

Co-chairs: Stephen S. Baek and Filippo Maggi



1120-1140

**F. Piscaglia**, Dept. of Aerospace Science and Technology, Politecnico di Milano, Milan, Italy  
**Accelerated reactive CFD simulations of aerospace propulsion systems in OpenFOAM**



1140-1200

**Francesco Nasuti**, Department of Mechanics and Aerospace Engineering, Sapienza University of Rome, Italy  
**Fluid-surface interaction and heat transfer in rocket propulsion**



1200-1220-Online

**Varunkumar S**, Department of Mechanical Engineering, Indian Institute of Technology Madras, Chennai - 600036, India.  
**A modelling approach to binder melt effects in AP-HTPB composite propellant combustion**

## 11 - Hybrid Rocket Propulsion

Co-chairs: **Alexander A. Gromov and Cristoph Kirchberger**



1220-1240

**Michael Gozin**, School of Chemistry, Tel Aviv University, Tel Aviv, Israel  
**Janus-type hypergolic fuels for hybrid systems using H<sub>2</sub>O<sub>2</sub> and HAN-based oxidizers**



1240-1300

**QianYou Wang**, College of Chemistry, Zhengzhou University, Zhengzhou, China  
**Fundamental insights into the hypergolic ignition with hydrogen peroxide oxidizer using carboranylthiolate-protected isomeric copper clusters**



1300-1430

**Lunch Break Lido La Playa**



1430-1450

**James 'Chris' Thomas**, Department of Mechanical Engineering, Texas A&M University, College Station, TX, USA  
**Ballistic behavior of metallized solid fuels for propulsion**



1450-1510

**Christian Paravan**, Dept. of Aerospace Science and Technology, Politecnico di Milano, Milan, Italy  
**Liquefying fuels for hybrid propulsion: Use of metal nitrides and 3D-printed cellular structures for enhanced regression rates**

## 12 – Future Chemical Propulsion

Co-chairs: **Jouke Hijlkema and Wei Zhang**



1510-1530

**Thomas M. Klapötke**, LMU Munich, Department of Chemistry, Munich, Germany  
**The enthalpies of sublimation and formation of nitrogen-rich energetic materials**





1530-1600

## Coffee/Tea Break Sala Pazienza



1600-1620

**A.A. Gromov**, TU Bergakademie Freiberg, Germany  
**On the green solid propellant's real application**



1620-1640

**Christoph Kirchberger**, German Aerospace Center (DLR), Institute of Space Propulsion, Hardthausen, Germany  
**Research and test activities on advanced rocket propellants at DLR's Institute of Space Propulsion in Lampoldshausen**



1640-1810

**Roundtable RT3 chaired by Qi-Long Yan, NWPU, China**

**Insensitive energetic materials**

**Panel of Experts:** Michael Gozin, Israel; Thomas M. Klapötke, Germany; Steve Son, USA.



1810-1820

## Closure of the Workshop

# LIST OF TECHNICAL SESSIONS AND CHAIRS

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