

# Report to APDIC, June 2023



**Associated Phase Diagram and  
Thermodynamics Committee (APDTC)**  
(Poland, Bosnia&Herzegovina, Bulgaria, Croatia, Czech  
Republic, Hungary, Montenegro, Romania, Serbia,  
Slovakia, Slovenia)

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**Ales Kroupa**

*Presented by:* **Ondrej Zobac**

# Associated Committee

## SUMMARY

1. **Associated Committee** consists of approx. 90 members from 11 countries and 32 scientific centers.
2. More than 90 scientific studies have been prepared by AC-members and published in 2022 as result of their work, mostly in JCR-indexed journals.
3. The AC-members from Czech Republic, Slovenia, Slovakia, Poland and Romania participated in nearly 20 different domestic and international projects.
4. 10 persons worked on their PhD thesis in under the supervision of Associated Committee members in 2022.
5. Six journals related with thermodynamics and phase equilibria are edited and published in AC-countries.

## Associated Phase Diagram and Thermodynamics Committee (APDTC)



# Rising materials classes and related materials systems

## APDTC-members are currently working and/or interested in following topics

Systems	Leading team	Comment
The ternary and multicomponent eutectic alloys of Al, Cu, Mg, Si, and Zn.	University of Belgrade, Technical Faculty, Bor (Serbia)	Good candidates to compete with salts as high-temperature phase change materials in latent heat thermal energy storage applications because of their high volumetric heat of fusion and excellent thermal reliability.
Low melting eutectic alloys based on Bi and In	University of Belgrade, Technical Faculty, Bor (Serbia)	Low melting eutectic alloys with melting point below 100 °C are showing increasing potentials in various thermal and energy management fields.
Cu-based shape memory alloys	University of Belgrade, Technical Faculty, Bor (Serbia)	CuAlNi, CuAlMn and CuAlNiMn alloys with or without microalloying elements. Potential applications in mechanical engineering and electronics.
Electrical contact materials based on Ag pseudo alloys (composites) dispersion hardened with metal or metal oxide nanoparticles e.g. W, Ni, CdO, SnO <sub>2</sub> , ZnO, In <sub>2</sub> O <sub>3</sub> .	University of Belgrade, Technical Faculty, Bor (Serbia)	Contacts operate under very complex conditions and endure joint and mutually dependent effects of electrical, thermal and mechanical nature. This is reflected in the fact that the heat is generated in a contact pair as a consequence of a contact resistance (Joule heating) even under nominal load. This becomes even more evident in nonstandard operation conditions that can potentially generate quite a lot of heat e.g. overload or short circuit load and/or arc formation during make and break operations (pre-close and bounce arcs). Therefore, assessment, simulation, and prediction of electrical contacts' performance under different operating conditions require reliable and accurate thermodynamic parameters and other relevant property data.

# Rising materials classes and related materials systems

## Table continuation

Systems	Leading team	Comment
B-Fe-X systems	Institute of Materials Research, SAS, Kosice (Slovakia)	Phase diagram study as subsystems of materials for high temperature applications.
Binaries and ternaries with Ir	Institute of Materials Research, SAS, Kosice (Slovakia)	Subsystems of potentially suitable construction materials for the space industry.
Wrought aluminium alloys	University of Ljubljana, Department of Materials and Metallurgy (Slovenia)	Using thermodynamics and phase diagram calculations to predict and optimize the various heat treatments.
Casting aluminium alloys	University of Ljubljana, Department of Materials and Metallurgy (Slovenia)	The change of small amounts of alloying elements in cast alloys is simulated to develop new alloys and improve some properties of existing ones.
Steels	University of Ljubljana, Department of Materials and Metallurgy (Slovenia)	The influence of different alloying elements and atmospheres on high-temperature oxidation and the formation of oxide layers in different tool steels is simulated. The course of steel production is also simulated
Reaction kinetics	University of Ljubljana, Department of Materials and Metallurgy (Slovenia)	The formation kinetics of the interaction layer between the molten aluminium and the tool steels was studied. The thermodynamic stability of the carbides in the microstructure of the steel was calculated and the effect of the alloying elements in the steels on the activity of the aluminium in the ferritic matrix was simulated.

# Rising materials classes and related materials systems

## Table continuation

Systems	Leading team	Comment
nano-materials; materials for CO <sub>2</sub> -capture; Cu/Nb-Ti alloys for superconductivity; boride coatings on steel for corrosion protection in liquid metals amorphous alloys	University of Miskolc, Miskolc (Hungary)	
Lead-free solders Sn-Ag-Cu-X (X = Bi, Ga, Ni)	Slovak University of Technology, Faculty of Materials Science and Technology, Trnava	Solder systems Sn-Ag-Cu-X (X = Bi, Ga, Ni) are interesting to study due to the additional elements (Bi, Ga, Ni) which are promising to improve the solders properties. These systems are also suitable for phase-field modeling..
Al-Pd-Co, Al-Co-Cu systems	Slovak University of Technology, Faculty of Materials Science and Technology, Trnava	Systems Al-Pd-Co, Al-Co-Cu comprising quasicrystalline phases with complex structure. These phases are not yet completely included in thermodynamic databases.
Magnesium-based alloys	Institute of Metallurgy and Materials Science, Krakow (Poland)	Alloys based on magnesium, have ability for hydrogen storage, but also are intensively studied with respect of their use as biomaterials.
NASICON-related phosphates	University of Economics and Business, Wroclaw (Poland)	A solid solution with a variable Yb <sup>3+</sup> /Na <sup>+</sup> content. The NASICON-like phases form site defects (cationic vacancies) and high ionic conduction of Na <sup>+</sup> . The Eu <sup>3+</sup> doped phosphate can be also applied in optical remote temperature readout.

# Rising materials classes and related materials systems

## Table continuation

Systems	Leading team	Comment
Thermoelectric materials, Sb and Zn containing half-Heusler alloys	Masaryk University, Brno (Czech Republic)	Study of thermal stability, study of phase diagrams.
Bimetallic nanoparticles – Ag-based, Ni-based	Masaryk University, Brno (Czech Republic)	Study of thermal stability and surface properties, study of phase diagrams.
Al-based binaries and ternaries, e.g. Al-Cu-Si, Al-Ge-Mg, Al-Ge-Sn	Institute of Physics of Materials, CAS, Brno (Czech Republic)	Importance of Al-based system in industrial applications is clear and not all information about phase diagram and properties of phases are known.
Se-Sn-X (X = Ag, Co, Fe, Ni, Pb, Te, Ti)	Institute of Physics of Materials, CAS,, Brno (Czech Republic)	The goal of the project is to advance our fundamental understanding of complex phase diagrams, crystal arrangement, thermodynamics and magnetism of selected intermetallic phases both in bulk form and containing interfaces, as these materials are promising as a basis of future advanced materials for photovoltaics, superconductors, thermoelectrics, etc.
Bi-Sr-Ca-Co-O system	Inst. of Chemical Technology, Prague, (Czech Republic)	Misfit cobaltites for thermoelectric applications in the Bi-Sr-Ca-Co-O system
La-Al-Mg-O system	Inst. of Chemical Technology, Prague, (Czech Republic)	Hexaaluminates as matrices for optically active dopants (RE3+)
FeCrCoNiCu high entropy alloys	Masaryk University, Brno (Czech Republic)	Experimental study and thermodynamic calculations

# Rising materials classes and related materials systems

## Table continuation

Systems	Leading team	Comment
RE-Ba-Cu-O system	Inst. of Chemical Technology, Prague, (Czech Republic)	REBCO based high temperature superconductors
Nanostructured catalysts based on oxides	Masaryk University, Brno (Czech Republic)	
Ni-based low-alloy steels	Technical University of Ostrava, Ostrava (Czech Republic)	Searching new ways of preparation. Obtaining of thermophysical, thermodynamic and kinetic behaviour (description) and experimental data. Utilization directly in the real technological processes. Dealing with various alloys (systems).
Aluminide coatings	Rzeszow University of Technology (Poland)	Modified aluminide coatings deposited on nickel and nickel superalloys.
Sb-based intermetallic compounds	Institute of Metallurgy and Materials Science, Krakow	Heat capacity, thermal stability.
micro and nanomaterials/functional materials; high entropy materials; nano/bio interface	Institute of Physical Chemistry "Ilie Murgulescu" of the Romanian Academy (Romania)	Thermodynamic properties and thermodynamics of processes.

## Associated Committee in 2022

Country	Scientific centers	AC-members	Papers published	Grants ongoing	BSc students	MSc students	PhD students
Bosnia and Herzegovina	1	1	1	0	0	0	0
Bulgaria	4	5	9	0	0	0	0
Croatia	1	1	1	0	0	0	0
Czech Republic	4	16	7	4	5	6	4
Hungary	1	5	7	0	0	0	2
Montenegro	1	2	0	0	0	0	0
Poland	9	28	45	3	0	0	3
Romania	1	3	2	0	0	0	0
Serbia	6	23	9	0	0	0	0
Slovakia	2	7	9	10	0	3	0
Slovenia	2	2	8	0	4	3	1



# Associated Committee members

## POLAND

<p><b>AGH – University of Science and Technology</b> Faculty of Non-ferrous Metals</p>	<p>Stanislaw Malecki Krzysztof Fitzner Boguslaw Onderka Dominika Jendrzejczyk-Handzlik</p>	<p><b>Wroclaw University of Technology</b>  Faculty of Chemistry <i>Group of Chemical Metallurgy</i></p>	<p>Leszek Rycerz Ida Chojnacka Anna Dańczak Marek Jasiorski Szczepan Roszak</p>
<p><b>Jagiellonian University</b> Faculty of Physics, Astronomy and Applied Computer Science</p>	<p>Rafał Kozubski</p>	<p><b>Institute of Low Temperature and Structure Research</b></p>	<p>Jacek Ćwik</p>
<p><b>Wroclaw Medical University</b> Department of Analytical Chemistry</p>	<p>Wiesław Gawęł Igor Mucha</p>	<p><b>Wrocław University of Economics and Business</b> Faculty of Engineering and Economics, Department of Inorganic Chemistry</p>	<p>Irena Szczygieł Aleksandra Pelczarska Beata Salamon Bożena Pilarek</p>
<p><b>Silesian University of Technology</b></p>	<p>Tomasz Maciąg</p>	<p><b>Rzeszow University of Technology</b></p>	<p>Jolanta Romanowska</p>

# Associated Committee members

## POLAND – cont...

<b>Institute of Metallurgy and Materials Sciences, Polish Academy of Sciences</b>	Wladyslaw Gasior Tomasz Czeppe Adam Debski Przemyslaw Fima	Grzegorz Garzel Tomasz Gancarz Piotr Ozga	Anna Wierzbicka–Miernik Anna Sypien
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## BULGARIA

## BOSNIA & HERZEGOVINA

<b>University of Plovdiv</b> Faculty of Chemistry	Georgi Patronov Georgui Vassilev	<b>University of Zenica</b> Faculty of Metallurgy and Materials Science	Diana Ćubela
<b>University of Ruse</b> Department of Materials Science	Parvoletka Docheva		
<b>Univ. Food Technology - Plovdiv</b> Department of Materials Science	Vanya Gandova		
<b>Medical Univ of Plovdiv</b> Faculty of Pharmacy, Dept. Chemical Science	Nikolina Milcheva		

## CROATIA

## MONTENEGRO

<b>University of Zagreb Faculty of Metallurgy - in Sisak</b>	Tamara Holjevac-Grgurić	<b>Montenegro University</b> Faculty of Metallurgy and Chemical Technology	Vanja Asanovic Kemal Delijic
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# Associated Committee members

## CZECH REPUBLIC

<b>Masaryk University, Brno</b>	Pavel Broz Jana Pavlu Mojmir Šob Jiri Sopousek Jan Vrestal Monika Vsianska	<b>Institute of Physics, AS CR, Brno</b>	Jiri Bursik Tomas Kana Ales Kroupa Milan Svoboda Adéla Zemanová Ondrej Zobac
<b>Institute of Chemical Technology, Prague</b>	David Sedmidubsky	<b>Technical University of Ostrava, Ostrava</b>	Bedřich Smetana Monika Kawolukova Simona Zla

## SLOVAKIA

## SLOVENIA

<b>Institute of Materials Research, SAS, Kosice</b>	Viera Homolova	<b>University of Ljubljana, Department of Materials and Metallurgy, Faculty of Natural Sciences and Engineering</b>	Jozef Medved
<b>Faculty of Materials Science and Technology (Trnava), Slovak University of Technology in Bratislava</b>	Roman Čička Marián Drienovský Marián Palcut Jozef Krajčovič Ivonka Černičková Libor Ďuriška	<b>University of Maribor, Faculty of Mechanical Engineering, Maribor</b>	Zupanić Franc

# Associated Committee members

HUNGARY		ROMANIA	
<b>University of Miskolc, Miskolc</b>	George Kaptay Andras Roosz Tamas Mende Ádám Végh József Korózs	<b>Institute of Physical Chemistry “I.G. Murgulescu” of the Romanian Academy</b>	Speranta Tanasescu Cornelia Marinescu Florentina Maxim

SERBIA			
<b>University of Belgrade, Technical Faculty, Bor</b>	Dragan Manasijević Nada Strbac Ljubiša Balanović Aleksandra Mitovski	Uroš Stamenković Ivana Marković Srba Mladenović Svetlana Ivanov	Saša Marjanović Milan Gorgievski
<b>Mining and Metallurgy Institute, Bor</b>	Ana Kostov Lidija Gomidzelovic Aleksandra Milosavljevic Zdenka Simsic- Stanojevic	<b>University of Belgrade, Institute of Chemistry, Technology and Metallurgy Faculty of Technology and Metallurgy, Belgrade</b>	Nadezda Talijan Vladan Cosovic  Jelena Miladinovic
<b>Institute for nuclear and other raw materials, Belgrade</b>	Miroslav Sokic Branislav Markovic	<b>University of Pristina, Faculty of Technical Sciences, Kosovska Mitorvica</b>	Dusko Minic Milena Premovic Aleksandar Dordevic Milica Tomovic

## Journals related with thermodynamics and phase equilibria published in AC-countries

**Archives of Metallurgy and Materials**, IF = 0.633, Citescore = 1.4,  
<https://www.journals.pan.pl/amm> Open Access, no publication fees

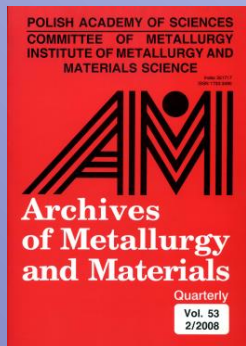
**Journal of Mining and Metallurgy Sect. B Metallurgy**, IF = 1.311, Citescore = 2.2,  
<http://www.jmmab.com/> Open Access, no publication fees

**Journal of Thermal Analysis and Calorimetry**, IF = 4.755, Citescore = 7.4,  
<https://www.springer.com/journal/10973>

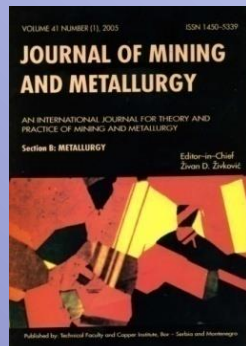
**Kovove Materialy – Metallic Materials**, IF = 0.690, Citescore = 1.6,  
<http://www.kovmat.sav.sk/> Open Access, no publication fees

**Metalurgija**, Citescore = 1.4,  
<https://pubweb.carnet.hr/metalurg/journal-metalurgija-2> Open Access

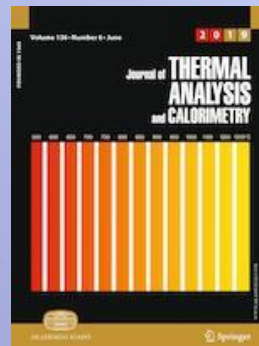
**Revue Roumaine de Chimie**, Citescore = 0.6  
<https://revroum.lew.ro/>



POLAND



SERBIA



HUNGARY



SLOVAKIA



CROATIA



ROMANIA

## Conferences related with thermodynamics and phase equilibria organized in APDTC-countries

18th Discussion Meeting on Thermodynamics of Alloys TOFA 2022, 12-16.09.2022, Krakow, Poland,  
<https://tofa2022.pl/>

International Conference Diffusion Fundamentals IX, 21-24.09.2022, Krakow, Poland,  
[https://diffusionfundamentals2021.confer.uj.edu.pl/en\\_GB/home](https://diffusionfundamentals2021.confer.uj.edu.pl/en_GB/home)

31st Joint Seminar Development of Materials Science in Research and Education, 5-9.09.2022, Nová Lesná,  
Slovakia <https://dms.fzu.cz/31/>

62nd International Foundry Conference (IFC), 14-16.09.2022, Ljubljana, Slovenia, <https://www.drustvo-livarjev.si/home>

## Selected books and monographs published in APDTC-countries

J. Sieniawski (ed.), Fizyka metali. Laboratorium. Politechnika Rzeszowska, 2022, ISBN: 978-83-7934-572-4

PALCUT, Marián (ed.). Microstructure and Corrosion Behavior of Advanced Alloys. 1st Ed. 2022; Basel: MDPI.  
396 p. ISBN 978-3-0365-3045-1. DOI: <https://doi.org/10.3390/books978-3-0365-3045-1>.

## Awards granted in the reported year

J. Romanowska – Award of the Rector of Rzeszow University of Technology

A. Debski – Silver Cross of Merit (awarded by President of Poland)



TOFA 2022 in numbers:

- 73 participants representing institutions from 21 countries
- 5 days with 11 sessions and 1 poster session
- 44 oral presentations, including 4 invited talks, and 31 posters
- 8 young participant fees waved thanks to support from Poland's Ministry of Education and Science (DNK/SP/514204/2021). Young participants constituted nearly 1/3 of all participants.

Przemyslaw Fima, Chair of TOFA 2022, <https://tofa2022.pl/>