

PERSONAL INFORMATION

Family name, first name: BALÁŽ, Matej

Date of birth: 09.04.1988

Nationality: Slovak

Researcher unique identifier (s): ORCID 0000-0001-6563-7588, WOS ResearcherID AAK-7505-2020

URL of web site: https://www.sav.sk/?lang=en&doc=user-org-user&user_no=8905

EDUCATION

2024 DSc.
Slovak Academy of Sciences, Slovakia

2015 PhD.
Faculty of Metallurgy, Technical University in Košice, Slovakia (supervising institution: Institute of Geotechnics, Slovak Academy of Sciences), PhD. advisor: Dr. Erika Dutková

2011 Master
Faculty of Natural Sciences, P. J. Šafárik University in Košice, Slovakia

CURRENT POSITIONS

2024 – leading researcher
Institute of Geotechnics, Slovak Academy of Sciences

PREVIOUS POSITIONS

2016 – 2024 independent/senior researcher
Institute of Geotechnics, Slovak Academy of Sciences

2015 – 2016 researcher, post-doc
Institute of Geotechnics, Slovak Academy of Sciences

FELLOWSHIPS AND AWARDS

2024 Award, Outstanding reviewer, RSC Mechanochemistry journal

2023 Award, laureate of the ESET Science Award in the category “Exceptional young scientist”, ESET company, Slovakia (prize awarded by the committee chaired by a Nobel prize laureate)

2023 Scholarship, ERC Visiting Fellowship SAS-UPJS, Ruhr-Universität Bochum, Germany, 3 months (05/2023 - 07/2023)

2022 Award, 3rd place in the competition “Young researcher of Slovak Academy of Sciences under 35 years”

2022 Award, listed in Stanford-Elsevier Ranking of top 2% top-cited researchers

2021 Award, finalist of the ESET Science Award in the category “Exceptional young scientist”, ESET company, Slovakia

2021 Award, Prize of Slovak Academy of Sciences for popularization

2021 Scholarship, International Visegrad Fund scholarship, Rzeszow University, Poland 10 months (09/2020 - 06/2021)

2020 Award, 3rd place in the competition Falling Walls Lab Slovakia

2019 Award, winner of the competition “Scientist of the year 2018” in the category “Young researcher” in Slovakia

2018 Award, prize for exceptionally highly cited publication, Slovak Academy of Sciences

2017 Scholarship, research stay within the framework of BMBF project, Technical University of Clausthal, Germany, 1 month, (01/2017)

2016 Scholarship, research stay within the framework of BMBF project, Technical University of Clausthal, Germany, 1 month, (06/2016)

2016 Award, 1st place in the competition “Young researcher of Slovak Academy of Sciences under 35 years”

2016 listed in the ranking of “Top 30 under 30 Slovaks” (member of top 5 in the category “Science”) in the magazine Forbes Slovakia

2016-2019 Štefan Schwarz fellowship, Slovak Academy of Sciences

2011 Award, 1st place, Student Scientific Conference, P.J. Šafárik University, Košice, Slovakia

2009 Award, 2nd place, National Round, 11th Slovak Student Scientific Conference, Slovak University of Technology, Bratislava, Slovakia

SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS (if applicable)

2022 – 2024 7 Postdocs
Ivan Franko Lviv University, Ukraine (1)

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| | Rzeszow University, Poland (3) |
| | Al-Farabi Kazakh National University, Kazakhstan (2) |
| | University of Belgrade, Serbia (1) |
| 2022 – 2024 | 8 PhD. students |
| | Technical University in Košice, Slovakia (3, 2 defended) |
| | Al-Farabi Kazakh National University (5, 3 defended) |
| 2015 – 2020 | 5 Master students |
| | University of Veterinary Medicine and Pharmacy in Košice, Slovakia (7, 4 as a supervisor-specialist) |
| | P. J. Šafárik University in Košice, Slovakia (1) |
| | University of Pardubice, Czech Republic (1 as a supervisor-specialist) |

TEACHING ACTIVITIES

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| 2021 – 2021 | Invited lecturer – Mechanochemistry, Faculty of Chemistry and Chemical Technology, Al-Farabi Kazakh National University, Kazakhstan, in-person, 1 month (11/2021) |
| 2025 | course “Materials Mechanochemistry” for PhD. students, Faculty of Chemistry and Chemical Technology, Al-Farabi Kazakh National University, Kazakhstan, remotely, 1 semester (15 weeks) |

INVITED LECTURES

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| 2025 | 11th International Conference on Mechanochemistry (Berlin, Germany) |
| 2025 | 8th International Clay Conference (Dublin, Ireland) |
| 2025 | 29th International Symposium on Metastable, Amorphous, and Nanostructured Materials (Bratislava, Slovakia) |
| 2024 | 11th International Workshop on Advanced Materials Science and Nanotechnology (Danang, Vietnam) |
| 2023 | 24th Polish Conference of Chemical and Process Engineering (Szczecin, Poland) |
| 2023 | webinar of the journal Molecules |
| 2022 | 10th International Conference on Mechanochemistry and Mechanical Alloying (Cagliari, Italy) |
| 2021 | NSF Center for the Mechanical Control of Chemistry (Texas, USA) |
| 2020 | IV. Sustainable Raw Materials International Project Week (Miskolc, Hungary) |
| 2017 | Materials Science & Technology 17 (Pittsburgh, USA) |
| 2014 | XVI European Symposium on the Quality of Eggs and Egg Products (Nantes, France) |

ORGANISATION OF SCIENTIFIC MEETINGS (if applicable)

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| 2017 | Member of the organizing committee of the 9th International Conference on Mechanochemistry, Košice, Slovakia, approx. 120 participants from approx. 30 countries |
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INSTITUTIONAL RESPONSIBILITIES

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| 2024 | Member of the Scientific Board, Institute of Geotechnics, Slovak Academy of Sciences, Slovakia |
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REVIEWING ACTIVITIES (if applicable)

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| 2025 | Scientific Advisory Committee of the 11 th International Conference on Mechanochemistry, Berlin, Germany |
| 2023 | Associate Editor, journal Frontiers in Chemistry |
| 2022 | Scientific Advisory Board of the 10 th International Conference on Mechanochemistry, Cagliari, Italy |
| 2021 | Editorial Board, journal Powder Metallurgy Progress |
| 2021 | Topical Advisory Panel, MDPI journal Nanomaterials |
| 2020 – 2023 | Review Editor, journal Frontiers in Chemistry |
| 2020 - 2025 | Editorial Board, MDPI journal Molecules (section Green Chemistry) |
| 2018 – 2020 | Guest Editor, special issue in MDPI journal Molecules entitled “Recent Development of Mechanochemical Synthesis I” |

MEMBERSHIPS OF SCIENTIFIC SOCIETIES (if applicable)

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|--------|---|
| 2025 – | member of the IUPAC Inorganic Chemistry Division |
| 2025 – | member of the Mechanochemistry Working Party within the European Chemical Society |
| 2025 – | Presidium member of the Slovak Chemical Society |
| 2023 – | Member, Young Academy of Europe |

- 2023 – Member, Slovak Chemical Society (since 2024: head of expert group “Solid-state chemistry and mechanochemistry”)
- 2022 – Member, Slovak National Committee IUPAC

MAJOR COLLABORATIONS

- prof. Dr. Franziska Emmerling, in situ monitoring of mechanochemical reactions, Federal Institute for Materials Research and Testing (BAM), Berlin, Germany
- prof. Dr. Lars Borchardt, in situ monitoring of mechanochemical reactions, Ruhr-Universität Bochum, Germany
- prof. Dr. Bolat Uralbekov, photocatalysis, Al-Farabi Kazakh National University, Kazakhstan
- Assoc. prof. Dr. Nina Daneu, TEM analysis of mechanochemically prepared samples, Jozef Stefan Institute, Ljubljana, Slovenia
- Dr. Tihana Mudrinić, mechanochemical synthesis and evaluation of materials capable of hydrogen generation via electrocatalytic water splitting, University of Belgrade, Serbia
- Dr. Yaroslav Shpotyuk, characterization of nanoscale materials, Institute of Physics, University of Rzeszow, Poland
- prof. Dr. Tomislav Friščić, ball-free mechanochemistry, University of Birmingham, United Kingdom
- FRITSCH company (Dr. Maik Paluga), Germany, secured contract for 120 000 eur
- AIMPLAS company (Dr. Giacomo Marra), Spain, secured contract for 10 000 eur
- CRB Benelux company (Dr. Pietro Rando), the Netherlands, secured contract for 5 000 eur
- Retsch company (Dr. Tanja Butt), Germany

TRACK RECORD OF GRANTS AND FUNDING

Current grants (please indicate “No funding” when applicable):

| Project title | Funding source | Amount (Euros) | Period | Role of the PI | Relation to current Impulz proposal ² |
|---------------------|------------------|----------------|--------------------------|----------------------------|--|
| APVV-24-0353 | SRDA (SK) | 301 800 | 09/2025 – 08/2029 | princ. investigator | Mechanochemical synthesis of broad scope of metal chalcogenides also via MSR (including ball-free approach) for electrocatalytic water splitting. Carbides, modelling new reactor development and high-entropy concept is NOT included. |
| BR28712843 | NCSTE (KZ) | 1 050 000 | 07/2025 – 12/2027 | investigator | none |
| APVV-23-0372 | SRDA (SK) | 199 976 | 07/2024-06/2028 | investigator | none |
| SK-PL-23-0002 | SRDA (SK) | 4 800 | 01/2024-12/2025 | investigator | Glasses based on metal chalcogenides (arsenic selenides) are investigated |
| 2/0036/23 | VEGA (SK) | 40 000 | 01/2023 – 12/2026 | investigator | none |
| 2/0112/22 | VEGA (SK) | 62 000 | 01/2022–12/2025 | princ. investigator | In one of three tasks, metal sulfides are synthesized utilizing natural and waste materials as a source of sulfur (not via MSR) |

On-going and submitted grant application (please indicate "None" when applicable):

| Project title | Funding source | Amount (Euros) | Period | Role of the PI | Relation to current Impulz proposal ² |
|---------------|----------------|----------------|-----------------|----------------|--|
| n/a | VEGA (SK) | 98 540 | 01/2026-12/2029 | investigator | Mechanochemical synthesis of metal chalcogenides also via MSR. |

^{*2} Describe clearly any scientific overlap between your Impulz application and the current research grant or on-going grant application.

PUBLICATION TRACK RECORD

1. BALÁŽ, Matej - DŽUNDA, Róbert - BUREŠ, Radovan - SOPČÁK, Tibor - CSANÁDI, Tamás. Mechanically induced self-propagating reactions (MSRs) to instantly prepare binary metal chalcogenides: assessing the influence of particle size, bulk modulus, reagents melting temperature difference and thermodynamic constants on the ignition time. In RSC Mechanochemistry, 2024, vol. 1, no.1, p. 94-105. DOI: 10.1039/D3MR00001J, ISSN 2976-8683, cited 0 times.

This is a pioneering study in pursuing MSRs for multiple metal chalcogenides systems. It shows an option to ignite MSRs in a very short timeframe and provides hypotheses about the factors governing MSRs of those systems. Thus it serves as a great basis for UNLEASH project. The idea, experiments, analysis and paper writing was in the hands of Dr. Baláž.

2. BALÁŽ, Matej - BIRINCI, Mustafa - SENTURK, Kader - ACHIMOVIČOVÁ, Marcela - BALÁŽ, Peter - TAMPUBOLON, Imelda Octa - STOLAR, Tomislav - BIENERT, Ralf - EMMERLING, Franziska - ERDEMOGLU, Sema - SIS, Hikmet - ERDEMOGLU, Murat. Utilizing Taguchi method and in situ X-ray powder diffraction monitoring to determine the influence of mechanical activation conditions on the physico-chemical properties and Al leachability of K-feldspar. In Journal of Materials Research and Technology-JMR&T, 2024, vol. 32, pp.3886-3895. (2023: 6.2 - IF, Q1 - JCR, 1.091 - SJR, Q1 - SJR). ISSN 2238-7854.

This paper reports a significant improvement of Al leachability from raw material- feldspar mineral via utilizing mechanical activation. The influence of milling conditions was assessed via a statistical approach (Taguchi method, ANOVA and regression analysis). This paper contains the in situ X-ray diffraction monitoring results obtained at synchrotron BESSY-II in Berlin by Dr. Baláž and his PhD. student (it was their first experience). A similar approach is planned to shed a light on MSRs mechanism of the systems targeted within the UNLEASH project.

3. BALÁŽ, Matej. Environmental Mechanochemistry Recycling Waste into Materials Using High-Energy Ball Milling. Switzerland : Springer International Publishing, 2021. 619 p. ISBN 978-3-030-75223-1, cited 17 times.

This monograph took four years to write. It contains an overview of more than 1000 studies devoted to the waste valorization using mechanochemistry, arranged into individual chapters based on waste type. It also contains Appendix, where all the studies are arranged based on the application scope of the recycled materials.

4. BALÁŽ, Matej - GOGA, Michal - HEGEDUS, Michal - DANEU, Nina - KOVÁČOVÁ, Mária - TKÁČIKOVÁ, Ľudmila - BALÁŽOVÁ, Ľudmila - BAČKOR, Martin. Biomechanochemical Solid-State Synthesis of Silver Nanoparticles with Antibacterial Activity Using Lichens. In ACS Sustainable Chemistry & Engineering, 2020, vol. 8, no.37, p. 13945-13955, DOI: 10.1021/acssuschemeng.0c03211, ISSN 2168-0485, cited 23 times.

The possibility to prepare bionanocomposites based on nano-silver using lichens as reducing agents using a solid-state methodology is described here. Dr. Baláž proposed the idea, analysed the data and coordinated all the communication with different co-authors.

5. BALÁŽ, Matej - DUTKOVÁ, Erika - LUKÁČOVÁ BUJŇÁKOVÁ, Zdenka - TÓTHOVÁ, Erika - KOSTOVA, Nina G. - KARAKIROVA, Yordanka - BRIANČIN, Jaroslav - KAŇUCHOVÁ, Mária. Mechanochemistry of copper sulfides: Characterization, surface oxidation and photocatalytic activity. In Journal of Alloys and Compounds, 2018, vol. 746, p. 576-582. DOI: 10.1016/j.jallcom.2018.02.283, ISSN 0925-8388, cited 38 times.

This study shows the possibility to prepare copper sulfides within a second-range and reports excessive characterization. In the end, also photocatalytic activity is described. Again, Dr. Baláž developed the idea, and managed the cooperation among various co-authors from both home and foreign institutions.

6. BALÁŽ, Peter - ACHIMOVIČOVÁ, Marcela - BALÁŽ, Matej - BILLIK, Peter - CHERKEZOVA-ZHELEVA, Zara - CRIADO, José Manuel - DELOGU, Francesco - DUTKOVÁ, Erika - GAFFET, Eric - GOTOR, Francisco José - KUMAR, Rakesh - MITOV, Ivan - ROJAC, Tadej - SENNA, M. - STRELETSKII, Andrey - WIECZOREK-CIUROWA, Krystyna. Hallmarks of mechanochemistry: From nanoparticles to technology. In Chemical Society Reviews, 2013, vol. 42, p. 7571-7637. DOI: 10.1039/c3cs35468g, ISSN 0306-0012, cited 788 times.

This pioneering review was invited by the guest editors of a special issue of prestigious Chem. Soc. Rev. journal. The invitation was received by prof. Baláž (the father of Dr. Baláž) and the contributions from the experts in inorganic chemistry from nine countries were gathered. It belongs among the highest cited papers in the field until now. Dr. Baláž was in charge of communicating with co-authors and wrote a very short section devoted to the bioconjugation of inorganic nanoparticles. He was in charge of technical work, English editing, formatting and preparing final submission.

TECHNOLOGY TRANSFER ACTIVITIES IN THE LAST 5 YEARS

Dr. Baláž has been involved in five technology transfer activities in the last five years.

Slovakia (3x)

Dr. Baláž cooperates with Technology Transfer Office of Slovak Academy of Sciences. So far, this resulted in the submission of one international and two Slovak patent applications as follows:

1. JACKO, Patrik - BEREŠ, Matej - BALÁŽ, Matej. Measuring system for measuring dynamic temperature changes in cylindrical grinding chambers. Košice : Technical University of Košice, Košice, 2023. Slovak patent application PP 50083-2023, date of application: 22.11.2023

The interdisciplinary cooperation between two electrotechnicians from Technical University of Košice and Dr. Baláž resulted in this invention. A transferrable device capable of monitoring temperature in the milling chamber each 80 ms was invented. Dr. Baláž proposed the idea and need to develop such a device and the electronics and software was developed by the colleagues from TU Košice. So far, the application is under evaluation.

2.+3. BALÁŽ, Matej. Method of synthesis of copper sulfides of covellite and digenite. Košice : Institute of Geotechnics, Slovak Academy of Sciences, 2024. Slovak patent application PP50046-2024, date of application: 31.07.2024

The discovery leading to it is the reason of undertaking the whole WP3 in the UNLEASH project, i.e. running ball-free reactions. The principle of this patent application lies in the possibility to ignite mechanically induced self-propagating reactions in the Cu-S system also without using milling balls and thus prepare the corresponding copper sulfides, namely covellite (CuS) and digenite (Cu_{1.8}S). Specific conditions have to be respected in order for the reaction to run in this way. The whole idea behind this was developed by Dr. Baláž, as it is clear by his sole authorship. The work was partly inspired by a superior activity of Cu-S system discovered already in 2016 and published in the journal RSC Adv. (<https://pubs.rsc.org/en/content/articlelanding/2016/ra/c6ra20588g>). To broaden the protection of this invention, the international application PCT/SK2025/000010 was submitted on July 30, 2025.

Kazakhstan (2x)

The two older technology transfer activities of Dr. Baláž involved the co-operation with his colleagues from Kazakhstan. In both cases, he served as a foreign supervisor of the PhD. students Dr. Shalabayev and Dr. Mussapyrova. Due to lack of space, only the bibliography details and a link to the paper describing the methodology is provided here

4. BURKITBAYEV, Mukash M. - SHALABAYEV, Zhandos S. - KHAN, Natalya Vladimirovna - BALÁŽ, Matej - URAKAEV, Farit. Method of obtaining needle-like nanocrystals of copper sulfide. National Institute of Intellectual Property, Ministry of Justice of the Republic of Kazakhstan : Al-Farabi Kazakh National University Republican State Enterprise on the Right of Economic Management of the Ministry of Education and Science of the Republic of Kazakhstan, 14.08.2020. Patent 5287.

<https://pubs.acs.org/doi/abs/10.1021/acssuschemeng.9b01849>

5. NADIROV, Rashid Kazimovich - MUSSAPIROVA, Lyazzat Arkhatovna - BALÁŽ, Matej. Method of copper extraction from waste copper slags. National Institute of Intellectual Property, Ministry of Justice of the Republic of Kazakhstan : Al-Farabi Kazakh National University“ Republican State Enterprise on the Right of Economic Management of the Ministry of Education and Science of the Republic of Kazakhstan, 28.04.2020. Patent 4900.

<https://www.sciencedirect.com/science/article/pii/S2238785421003173>