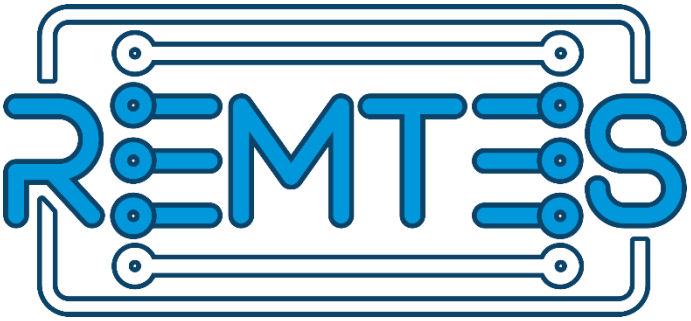
REMTES

TECHNOLOGY FOR REMOTE TEMPERATURE MEASUREMENTS IN MICROFLUIDIC DEVICES

PROGRAM-PRIZMA-2023-2026

Grant Agreement: 7017



Deliverable 4.3

Dissemination, communication, and exploitation plan

Version Final

This project is supported by the Science Fund of the Republic of Serbia, Grant No. 7017, Technology for remote temperature measurements in microfluidic devices – REMTES

Project Deliverable Information Sheet

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Technology for remote temperature measurements in microfluidic devices – REMTES

TABLE OF CONTENTS

This project is supported by the Science Fund of the Republic of Serbia, Grant No. 7017,
Technology for remote temperature measurements in microfluidic devices – REMTES

1. Introduction & Context

REMTES – "Technology for remote temperature measurements in microfluidic devices" is a Science Fund of the Republic of Serbia funded project (Program PRIZMA, Grant Contract 7017) coordinated and completely executed by "Vinča" Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade (VINS). The project will run from December 1st 2023 to November 30th 2026.

REMTES is a highly ambitious and innovative project aimed at developing a breakthrough system for measuring sample temperatures on the nanoliter scale. The project will develop an optical self-referencing thermometer for use in micro- and nanofluidics in the 0–100 °C temperature range by exploiting temperature-induced changes in the luminescence of materials and nanomaterials; that is, by advancing luminescence (nano-) thermometry in a targeted manner. The project aims to go beyond the state of the art and implement a radically new technology that merges the fields of luminescence thermometry, photothermal spectroscopy, and microfluidics to develop new-generation luminescent thermometry probes using cutting-edge luminescent, temperature-sensitive, and chemically stable inorganic materials in bulk and nanomaterial forms. The probes will be embedded in microfluidic chip channels to enable self-referenced remote temperature measurements, and the technology will be validated by a portable microfluidic luminescent thermometer, as well as in-situ temperature measurements of fluid flow in nanoliter volume samples. Multiple conceptual breakthroughs can be further envisaged from the proposed technology credibly spreading its impact to multiple technological areas.

Deliverable D4.3, the REMTES project's dissemination, communication, and exploitation (DCE) plan, is represented by the document that is being provided. This material is available to the public and is provided within the framework of Work Package 4 (WP4: Management, communication, dissemination, and exploitation), Subactivity 4.2: Knowledge dissemination, communication, and exploitation (months: 1-36). The dissemination, communication, and exploitation plan outlined in the REMTES project framework is being made available for the first time with this paper. Raising awareness, facilitating communication, and encouraging information exchange are the key goals of this plan to guarantee long-term advantages that extend beyond the project's completion. The dissemination, communication, and exploitation plan will be implemented through diverse channels, after considering the need to protect the intellectual property (IP) associated with the project results

2. The core of dissemination and exploitation of results

Dissemination and exploitation will be undertaken at three complementary levels:

1. **Dissemination for awareness** - to raise awareness of the general public about the project, the team, project Objectives, and impact, while building a project identity and profile);
2. **Dissemination for understanding** - to directly target researchers, academics, hospitals, laboratories, and SMEs that can deeply appreciate the project's research findings);
3. **Dissemination to do** - to target those of influence to bring about real change within their spheres of influence, such as clusters and technological platforms, policy groups, non-governmental organizations, and stakeholders).

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Technology for remote temperature measurements in microfluidic devices – REMTES

2.1. Publications

Results from the REMTES will be shared with the scientific community over the course of the project. The selected results will be published in scientific journals. Most of the project's publications will be released under open-access agreements at no cost to the user. Objectives will include multidisciplinary fields like nanotechnology, publishing for an industrial audience, and both fundamental and applied journals in physics, chemistry, and materials science. Scientific papers will mainly be published in journals (e.g., Nature Materials, Nature Communications, Advanced Materials, Advanced Optical Materials, Nano Letters, Nano Research, Nanoscale, Ceramics International RSC Advances, MDPI publisher) that offer grant self-archiving or open access publication and are classified as M21 in Serbia, as previously stated in the Data Management plan of the REMTES project. All open-access publications are available through the project website (https://www.remtes-prizma.org/). There will also be the implementation of open data management. The data generated throughout the project (measurement, simulations, etc.), along with any relevant supporting documentation, will be made publicly available on Zenodo through the project website upon publication in peer-reviewed journals, as long as it coordinates with potential exploitation.
Figure 1 schematically represents open access to scientific publication and research data in the wider context of dissemination and exploitation. All publications acknowledge the funding contribution of the Science Fund of the Republic of Serbia, using the following sentence: "This project is supported by the Science Fund of the Republic of Serbia, Grant No. 7017, Technology for remote temperature measurements in microfluidic devices – REMTES."
To date, REMTES team members have already published 3 and 2 scientific manuscripts (Annex I), therefore it is expected that the scientific production will increase during the upcoming years of the project. Annex I will be updated accordingly.

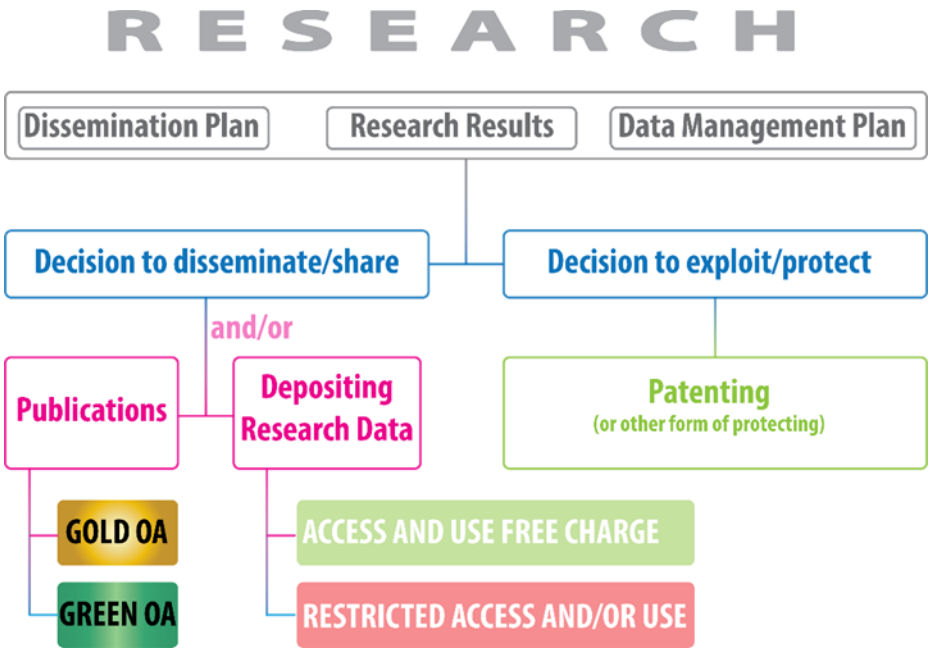

Figure 1. Open access to scientific publications and research data in the wider context of dissemination and exploitation

2.2. Conference participation and presentations

Results from the REMTES will be shared with the scientific community over the course of the project. According to the innovative nature of the project, we expect to deliver several invited lectures, oral and poster presentations and as well as participate in organizing international meetings (targeted at both the academic and industrial communities). It is intended to promote and disseminate the project's results to scientific and industrial representatives by attending a variety of well-established international conferences that are relevant to the project's topics throughout the length of the project. The targeted conferences are: The International Conference on Phosphor Thermometry, The International Conference on the Physics of Optical Materials and Devices (ICOM), The Phosphor Safari (International Symposium for Luminescent Materials), The International Workshop on Advanced Spectroscopy and Optical Materials – IWASOM, International Conference on Luminescence – ICL, and The European Conference on Luminescent Detectors and Transformers of Ionizing Radiation – LUMDETR).

To date, REMTES team members have already published 3 scientific manuscripts, and 2 scientific manuscripts are in preparation (Annex I), therefore it is expected that the scientific production will increase during the upcoming years of the project. Annex I will be updated accordingly.

2.3. Branding, leaflet, website, academic/professional/social networks

A project logo is designed and displayed in all relevant materials together with *the Science Fund of the Republic of Serbia* logo.

Figure 2. The logo of the REMTES project

A leaflet describing REMTES's objectives and expected impact is produced and distributed at conferences, workshops, meetings, and exhibits. So far, it was distributed at:

- The 66th International Fair of Techniques and Technical Achievements as part of the Ministry of Science, Technological Development and Innovation's setting "Play for Humanity!" Science for all: Step into a sustainable future!", May 21-24, 2024, Belgrade
- The 12th International Conference on Luminescent Detectors and Transformers of Ionizing Radiation, June 16-21, 2024, Riga, Latvia
- The 7th International Conference on the Physics of Optical Materials & The 4th International Conference on Phosphor Thermometry, 26th August – 30th August 2024, Becici, Montenegro

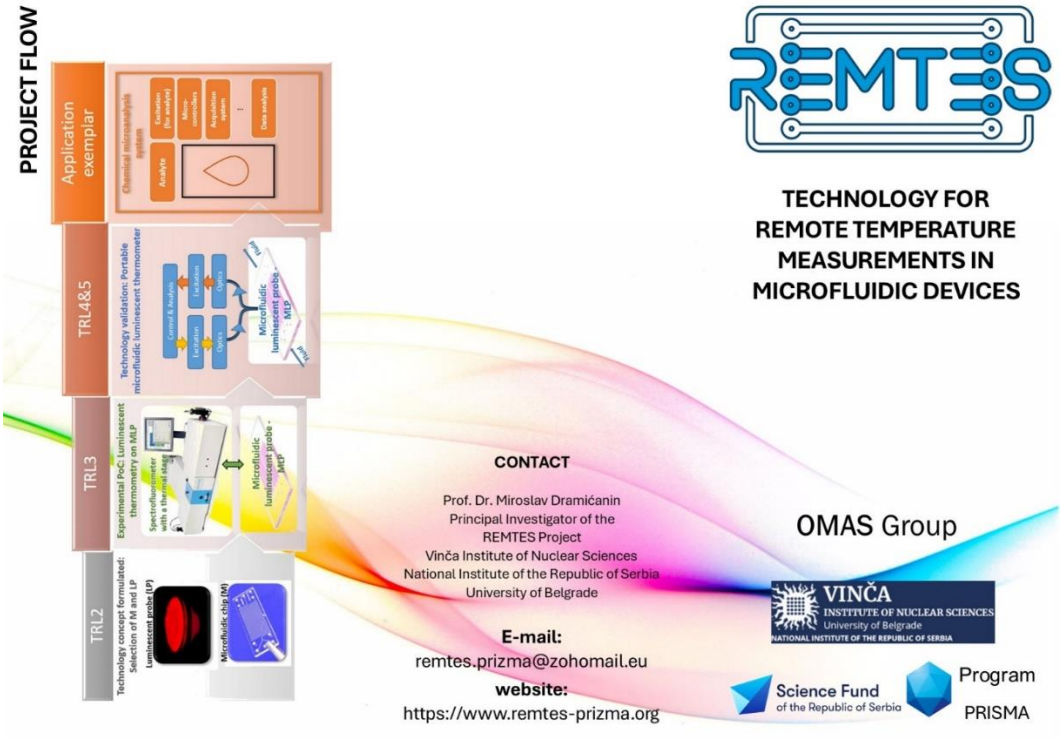

Figure 3. REMTES leaflet outer page

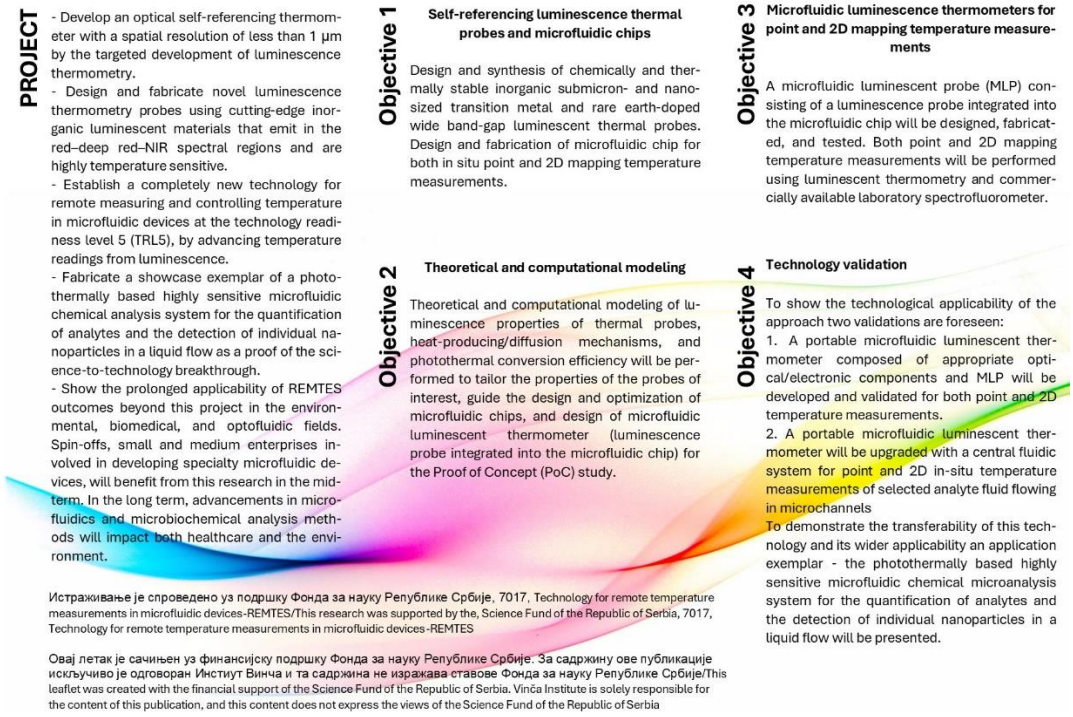

Figure 4. REMTES leaflet interior page

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The website was created in the first month of the project. https://www.remtes-prizma.org/

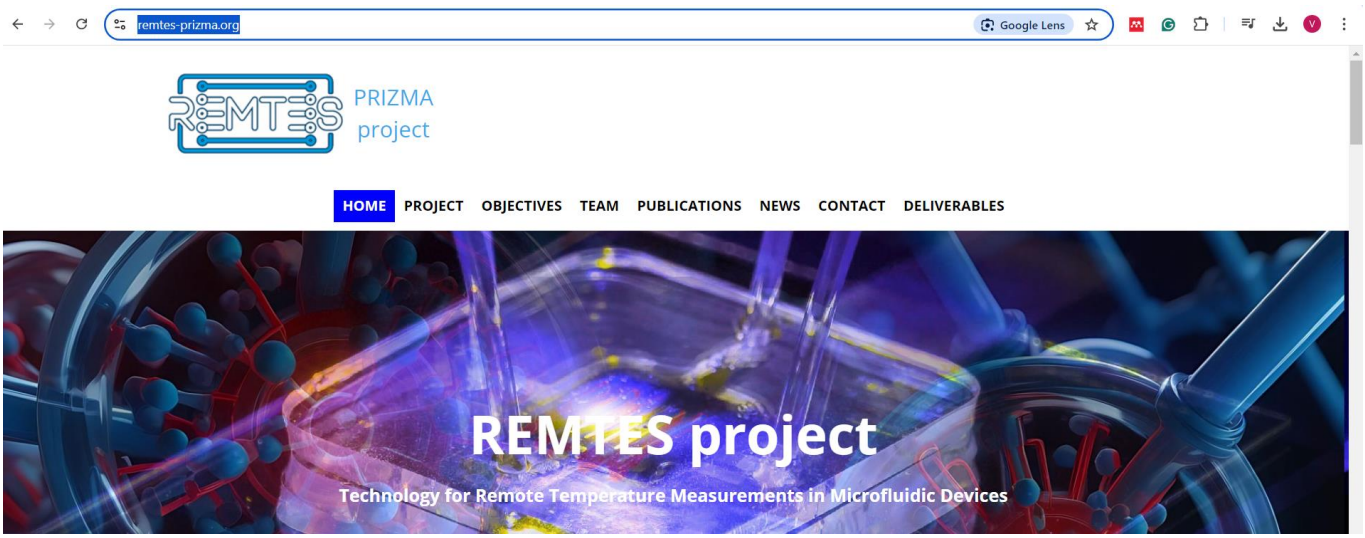

Figure 5. REMTES webpage image

The website outlining the project's research findings is designed to reach the general public, stakeholders, and industry representatives. Throughout the REMTES' life, the website will be updated on a regular basis, with relevant research results presented in a user-friendly format.

Promotional materials and quality multimedia content created during the lifetime of the project (website, leaflet, logo…) will be provided to *The Science Fund of the Republic of Serbia* to promote the fund to the public.

Furthermore, REMTES' Instagram profile is set up and updated on a regular basis with information about its activities. All team members contribute to the context and Dr. Mina Medić (TM7) is posting content.

Figure 6. REMTES Instagram profile page image

2.4. Two-day workshop

A two-day workshop on luminescent thermometry was organized as a special session during the International Conference on the Physics of Optical Materials and Devices (ICOM), which is traditionally organized by project team members (www.icomonline.org). The workshop was chaired by Prof. Dr. Miroslav Dramićanin (PI) and Dr. Željka Antić (WP1 head). It was designed to be an engaging platform for ICOM conference participants, aimed at optimizing the distribution of knowledge and promoting the groundbreaking discoveries and technologies developed by REMTES. In addition to highlighting REMTES' innovations, the workshop also emphasized the broader implications of luminescent thermometry in future applications, such as in materials science, biomedical engineering, and environmental monitoring. Participants were encouraged to consider collaborative opportunities that could arise from the intersection of their research areas and the technologies presented. A roundtable networking session was

held with participants from the REMRES, LEDtechGROW (Promis), and HYDIS (Prisma) programs. Beside the participants from the projects, 19 other participants from Serbia, China, Russia, France, Germany, Brazil, Italy, Bulgaria and Romania attended the workshop.

The program of the workshop was realized during 26-27. August 2024. As can be seen at https://icomonline.org/ICOM&ICPT2024_programe.pdf

2.5. Showcase

At the end of the project activities, a showcase will be organized, which will introduce the science underpinning portable microfluidic luminescent thermometer and the chemical microanalysis system and demonstrate the proposed technology. In addition to academia and industry, the showcase will also target Ph.D. students and the community of young researchers. Serbian companies, such as PIROGRAMS d.o.o., working in the field of remote thermometry, already expressed an interest in the REMTES project and the showcase participation. Also, preliminary contacts with SMEs and spin-offs from the EU (such as Cellbox Labs from Latvia, https://www.cellboxlabs.com/) working in the field of microfluidics were already made.

The showcase will be supported by Prof. Thomas Thundat, University at Buffalo who intends to contribute to the REMTES project by advising participants at all stages of implementation.

2.6. Exploitation

REMTES has the strong potential to advance science and develop new technology that can result in new IP. Exploitation and IP rights training started from the project's very start, aiming to provide team members with an understanding of their rights and duties in this regard. The exploitation strategy further on will be directed to companies interested in thermometry and chemical microanalysis in microfluidic and nanofluidic devices. This will be further on achieved through the *Innovation Fund of the Republic of Serbia* (http://www.inovacionifond.rs/). Therefore, we expect that a radically new chemical microanalysis system based on photothermal luminescence thermometry will attract the interest of companies working in this arena.

The Intellectual Property Office of the Republic of Serbia (www.zis.gov.rs) provides guidance on IP issues. Even though the invention may be too early for patent-filing consideration, *the Office* is involved from the start, so that the data/results needed for patent protection are collected and reported to *The Office* in readiness for patent filing. In addition, one of the WP4 team members Dr. Mina Medić (TM7) is designated as the project IP officer, who will undergo additional IP training. The IP officer will ensure that all papers, reports, and presentations are checked to confirm no IP is at risk. Dr. Aleksandar Ćirić (TM10) attended lectures dedicated to development and best practices in technology transfer, organized by Science Technology Park Belgrade. Dr. Vesna Đorđević (TM4) will participate in ACADEMIC RESEARCH SECURITY PROGRAM webinar organized by Sandia National Laboratories (SNL).

3. REMTES's communication activities

REMTES's communication activities are continuously monitored and regularly evaluated within WP4, and include:

• *Public websites and social networking.* The website comprises of basic information targeted to the general public, such as project description and objectives, team members, and news. It also lists specific information devoted to the scientific community and various parties linked to the project such as scientific and technical papers and deliverables. It is regularly updated by team members and managed

by Dr. Aleksandar Ćirić (TM10) for the website and Dr. Mina Medić (TM7) for Instagram.

• *Public outreach.* The general public will be addressed through various society-related activities, such as public lectures, local science festivals, open days, and workshops for high school and university students. Existing initiatives of the *Ministry of Education, Science and Technological Development of the Republic of Serbia* aimed at promoting public awareness of general science will be used to emphasize the importance of scientific research and its impact on society; i.e., through *the Center for the Promotion of Science (CPN, www.cpn.rs)*. Independent and nonprofit organizations, such as the *Petnica Science Center* – center for pre-university science talents *(www.petnica.rs)*, specialized scientific TV channels (such as *Brainz TV (www. brainz.center)*, and *RTS Nauka (https://www.rts.rs/page/tv/sr/news/3110/rts-nauka.html)*) are also possible conduits that can be used to address the general public and allow them to experience REMTES's technology and potential.

4. Conclusions

The current DCE Plan is the first version of the REMTES DCE Plan, and updates are planned for each time there are significant changes. The new version will be released on the month of 24, which coincides with the Fund's annual yearly report, if not sooner.

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Anex I

List of full-paper scientific publications – to be updated regularly in the DCE Plan and REMTES Website

No.	AUTHORS	ARTICLE TITLE	JOURNAL	STATUS
1.	**Katarina Milenković, Ivana Zeković,** Bojana Milićević, **Zoran Ristić,** Krisja nis Smits, Anatoli I. Popov, **Miroslav D. Dramićanin, Vesna Đorđević**	Microwave-assisted solvothermal synthesis of Eu3+-doped CsY2F7 and RbY2F7 phosphorescent nanoparticles	Ceramics International (M21)	Published
2.	Anđela Rajčić, Zoran Ristić, Jovana Periša, Bojana Milićević, Saad Aldawood, Abdullah N. Alodhay, **Željka Antić, Miroslav D. Dramićanin**	Using Principal Component Analysis for Temperature Readings from YF3:Pr3+ Luminescence	Technologies	Published
3.	**Tamara Gavrilović, Aleksandar Ćirić, Mina Medić, Zoran Ristić,** Jovana Periša**, Željka Antić, Miroslav D. Dramićanin**	Structure–Dopant Concentration Relations in Europium-Doped Yttrium Molybdate and Peak-Sharpening for Luminescence Temperature Sensing	Materials (M21)	Published
4.	**A Ćirić, Z Ristić, T Gavrilović,** J Periša**, M Medić,** B. Milićević**, MD Dramićanin**	Sensor fusion luminescence thermometry - better together		In preparation
5.	**Tamara Gavrilović, Vesna Đorđević,** Jovana Periša**, Mina Medić, Zoran Ristić, Aleksandar Ćirić, Željka Antić, Miroslav D. Dramićanin**	Luminescence Thermometry with Eu^{3+}-Doped $Y_2Mo_3O_{12}$: Comparison of Performance of Intensity Ratio and Machine Learning Temperature Read-outs		In preparation

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List of proceedings paper scientific publications – to be updated regularly

NO.	AUTHORS	ARTICLE TITLE	CONFERENCE	TYPE
1.	**Miroslav D. Dramićanin, Zoran Ristić**	Multiparameter Approaches for Improved Temperature Readings from Luminescence	12TH INTERNATIONAL CONFERENCE ON Luminescent Detectors and Transformers of Ionizing Radiation	Plenary
2.	**Z. Ristić, Sanja Kuzman, Miroslav D. Dramićanin**	Machine learning assisted thermometry of Mn^{5+} doped $Ca_6Ba(PO_4)_4O$ phosphor	The 7th International Conference on the Physics of Optical Materials and Devices (ICOM2024)	Invited
3.	**Aleksandar Ćirić, Zoran Ristić, Miroslav D. Dramićanin**	Sensor fusion luminescence thermometry	The 7th International Conference on the Physics of Optical Materials and Devices (ICOM2024)	Invited
4.	**Ljubica Đačanin Far, Aleksandar Ćirić, Katarina Milenković, Mina Medić**, Jovana Periša**, Tatjana Dramićanin, Miroslav Dramićanin**	IMPROVING SENSITIVITY OF LUMINESCENCE THERMOMETRY WITH YNbO4:Sm3+ BY EXPLOITING EMISSION FROM HIGH ENERGY $^4G_{7/2}$ EXCITED LEVEL	The 7th International Conference on the Physics of Optical Materials and Devices (ICOM2024)	Poster
5.	**Vesna Đorđević**, Anđela Rajčić, **Zoran Ristić**, Jovana Periša, Bojana Milićević, **Željka Antić, Miroslav D. Dramićanin**	Exploring Luminescence Thermometry Using Principal Component Analysis: Insights from Pr^{3+}-Doped YF_3	The 7th International Conference on the Physics of Optical Materials and Devices (ICOM2024)	Poster
6.	**Tamara Gavrilović**, **Aleksandar Ćirić, Mina Medić, Katarina Milenković, Zoran Ristić**, Jovana Periša, **Željka Antić, Miroslav Dramićanin**	Effect of Eu3+ doping on structure transitions in $Y_2Mo_3O_{12}:Eu^{3+}$ and its application as temperature sensing probe	The 7th International Conference on the Physics of Optical Materials and Devices (ICOM2024)	Poster
7.	Jovana Periša, **Aleksandar Ćirić, Željka Antić, Miroslav D. Dramićanin**	Advancing luminescence thermometry: Employing multiple fluorescence intensity ratios of $Y_3Al_5O_{12}:Er^{3+}/Mn^{4+}$ nanocrystals for supersensitive temperature sensing	The 7th International Conference on the Physics of Optical Materials and Devices (ICOM2024)	Poster
8.	**Ivana Zeković**, Jovana Periša, **Mina Medić, Aleksandar Ćirić**, Anđela Rajčić, Bojana Milićević, **Željka Antić, Miroslav D. Dramićanin**	Temperature stability of luminescent Eu^{3+}-activated Sr_2GdF_7 colloid incorporated in PVA fiber	The 7th International Conference on the Physics of Optical Materials and Devices (ICOM2024)	Poster

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