Dissemination, communication, and exploitation plan WP4 (D4.3)

LEDtech-GROW

LED TECHNOLOGY BASED ON BISMUTH-SENSITIZED Eu^{3+} LUMINESCENCE FOR COST-EFFECTIVE INDOOR PLANT GROWTH

PROGRAM-PROMIS-2024-2025

Grant Agreement: 10412

Deliverable 4.3

Dissemination, communication, and exploitation plan

Version: 2

Contractual Date Delivery: 29/12/2025

Project Deliverable Information Sheet

LEDtech-GROW Project	Project Ref. No. 10412
	Project Title: *LED technology based on bismuth-sensitized Eu^{3+} luminescence for cost-effective indoor plant growth*
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	Principal investigator: Dr. BOJANA MILIĆEVIĆ
	Abstract: The dissemination, communication, and exploitation plan provides a strategic framework for effectively promoting the LEDtech-GROW project. It establishes key objectives, identifies critical stakeholders and communication channels, and provides guidelines for communication and dissemination activities. The plan also outlines methods for evaluating the success of these initiatives, allowing for ongoing improvement and impact assessment.

Document Control Sheet

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Authorship	Written by Bojana Milićević and Ljubica Đačanin Far
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	Approved by Bojana Milićević

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Executive Summary

The document presented is deliverable *D4.3 – Dissemination, communication, and exploitation* plan of the LEDtech-GROW project. It is a public document delivered in the context of *WP4 - Management, communication, dissemination, and exploitation*, Task 4.2 - Dissemination, communication, and exploitation of knowledge.

This document presents the final release of the dissemination, communication, and exploitation plan envisioned within the LEDtech-GROW project. This comprehensive document outlines the target audiences, topics, and results for sharing information related to the LEDtech-GROW project. The main purpose of this plan is to raise awareness, facilitate communication, and promote knowledge sharing to ensure lasting benefits beyond the project's duration.

It outlines the actions, activities, and tools for collaborative dissemination within the community, ensuring alignment with both the project objectives and the specific activities of each work package. In addition, the document presents developed and planned dissemination activities, highlighting potential academic events and journals for future engagement.

The content of this document is complementary to other official documents that define obligations under the Grant Agreement (GA). It shall be considered a living document and, as such, will be periodically updated as necessary throughout the lifespan of the Project. The final version of the *Dissemination, Communication, and Exploitation*. The plan will be made available when the Project nears completion.

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Abbreviations and Acronyms

	Explanation
[DCE]	Dissemination, Communication, and Exploitation
[EU]	European Union
[GA]	Grant Agreement
[Gold Open Access]	Open access publishing (gold open access) means that an article is immediately provided in open access mode on the publisher or journal's website. Some publishers charge Article Processing Chargers (APCs) to make articles open.
[Green Open Access]	Self-archiving (green open access) means that a published article or the final peer-reviewed the manuscript is archived (deposited) in an online repository before, alongside, or after publication. In some cases, the author can delay access to the article (embargo period). H2020 rules state that embargo periods cannot exceed six months, except for publications in social science and humanities where the maximum embargo period is twelve months.
[IPR]	Intellectual Property Rights
[LEDtech-GROW]	Acronym of the Project Titled "*LED technology based on bismuth-sensitized Eu^{3+} luminescence for cost-effective indoor plant growth*"
[PAR]	Photosynthetically active radiation (400–700 nm of wavelength), an essential part of the light spectrum which typically drives photosynthesis more efficiently at the red and blue regions of the spectrum
[PI]	Principal Investigator
[PROMIS 2023]	The Program for Excellent Projects of Young Researchers (PROMIS) is a program of the Science Fund of the Republic of Serbia intended of excellent projects for young researchers in the early phase of their careers
[VinaR]	VinaR, i.e. Vinca Repository is a joint digital repository of all laboratories and departments in Vinča Institute of Nuclear Sciences, University of Belgrade. VinaR provides open access to the publications, as well as other outputs of the research projects implemented in these institutions.
[VINS]	"Vinča" Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade
[WP]	Work package
[Zenodo]	Zenodo is a catch-all research data repository that enables researchers, EU projects

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1. Introduction

LEDtech-GROW – "LED technology based on bismuth-sensitized Eu^{3+} luminescence for cost-effective indoor plant growth" is a Science Fund of the Republic of Serbia-funded project (Program PROMIS 2023, Grant Contract No. 10412), coordinated and fully executed by the "Vinča" Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade (VINS). The project will run from January 3rd, 2024, to January 2nd, 2026.

LEDtech-GROW is a highly ambitious and innovative project that aims to achieve a breakthrough in modern, efficient, and moisture-resistant LED illumination for plant growth, a key solution for successful future indoor agriculture production. LEDtech-GROW offers LED innovation that fully satisfies the needs of plants and cannot be achieved with any currently available LED technology. This project will develop inorganic phosphors that convert as much electrical energy as possible into the Photosynthetically Active Radiation (PAR) spectrum used by plant photoreceptors, which differs from the spectrum required for general lighting. In particular, double- and triple-wavelength-emitting phosphors will increase light output for cryptochrome and phytochrome photoreceptors while ensuring high color quality. The fundamental concept of inner-particle energy transfer between Bi^{3+} and Eu^{3+} ions is significant for developing plant-growth-targeted LEDs. Moreover, the LEDtech-GROW project will focus on the design and fabrication of highly efficient plant-grow-targeted LEDs based on bismuth-sensitized Eu^{3+}-activated single-component phosphors for the entire PAR spectrum.

The LEDtech-GROW project comprises two technical work packages as follows:

- WP1 Design, synthesis, and characterization of plant-growth-targeted phosphors
- WP2 Design, fabrication, and LEDs performance

Two non-technical work packages ensure the facilitation of the technical work, coordination of all the work packages, dissemination, and communication of the project results. These work packages include the following:

- WP3 Professional development of young and early-stage researchers
- WP4 Management, communication, dissemination, and exploitation

The present document – D4.3 - Dissemination, Communication, and Exploitation Plan – is a deliverable of WP4 and will be established and monitored by the PI and WP leaders (TM1, TM2, and TM3 team members). The primary aim of this document is to establish a comprehensive dissemination plan for the LEDtech-GROW project and to provide clear guidelines for all project members. The activities will include effective dissemination, raising awareness, facilitating communication, promoting knowledge sharing and technology transfer, exploring commercial opportunities, and identifying potential companies interested in using LEDs for plant cultivation.

Our strategy emphasizes building strong relationships with a diverse range of stakeholders, including industry partners, academic institutions, and the broader community. We are also committed to clearly communicating the project's outcomes and actively seeking feedback from these audiences.

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Creating a cohesive identity for the project will help ensure that our messaging resonates with diverse groups and enhances the project's visibility. Given the dynamic nature of dissemination activities, it is essential to update and adapt the plan regularly. The Dissemination and Communication (DCE) Plan will serve as a living document, remaining current even after its formal delivery. This collaborative approach will engage all project members in actively contributing to our dissemination efforts.

We will continuously monitor and report on these activities throughout the project's lifecycle, ensuring that we remain responsive to emerging opportunities and feedback. By focusing on these principles, we aim to maximize the impact of the LEDtech-GROW project and ensure its long-term relevance in the field.

Our dissemination efforts focus on two specific objectives:

- Awareness Creation and Communication: We aim to raise awareness of the project and communicate results clearly to a wide range of audiences. This will involve disseminating information through multiple channels and fostering dialogue to maximize the reach and impact of our findings.
- Knowledge Sharing and Stakeholder Engagement: Active stakeholder engagement is essential to ensure the sustainability of the project's impacts beyond its duration. This includes facilitating knowledge transfer and collaboration, thereby creating a network of interested parties who can continue to utilize and build upon the project's outcomes.

By focusing on these objectives, we aim to enhance the visibility of the LEDtech-GROW project while ensuring its long-term relevance and applicability in the field.

2. Dissemination Plan

Dissemination is the public sharing of research results through appropriate channels, including scientific publications in multiple formats. A well-crafted dissemination plan facilitates the transfer of knowledge and findings to stakeholders who can leverage them most effectively. This approach maximizes research impact, allowing benefits to extend beyond the initial focus while preventing results from being overlooked.

Dissemination pertains to the communication of all results that are not constrained by intellectual property protections. One of the primary goals of the LEDtech-GROW project is to develop scientific and technological leadership in the field of inorganic nanomaterials and LED devices. This will be achieved through targeted and diverse dissemination of project results to the scientific community.

Planned Dissemination Activities: The overarching goal of our dissemination efforts is to promote knowledge, raise public awareness, foster education, and enhance transparency. Effective dissemination also encompasses how communication is executed, the intended audience, and the methods employed. Our strategy aims to highlight the social impact and the exploitation of the project's potential to the general public and the scientific and industrial communities.

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To communicate the project's outcomes effectively, we must consider the specific needs (including language, methods, and content) of each target audience. Table 1 summarizes the planned dissemination actions for the LEDtech-GROW project, tailored to various audiences, and the messages we aim to convey.

Table 1: Dissemination activities

ACTIVITIES	TARGET AUDIENCES	INDICATORS
Website	The scientific community, the general public, stakeholders, and academia	Number of visitors
Logo	The scientific community, the general public, shareholders, and academia	Logo recognition
Leaflet	The scientific community, the general public, shareholders, and academia	Contact requests, demonstrations of interest
Social media	The scientific community, the general public, shareholders, and academia	Number of followers
Press releases and public outreach (magazines, radio, TV)	The scientific community, the general public, shareholders, and academia	Number of appearances, number of interviews, speeches
Publications in peer-reviewed journals	Scientific community	Impact factor, citations, downloads
Scientific Events: conferences, lectures, seminars	Scientific community, general public, shareholders, and academia	Number of invited talks, oral presentations, and posters
Public Events: Fairs, Researchers' Night	Scientific community, general public, shareholders, and academia	Contact requests, demonstrations of interest
Roll-up (s)	Scientific community, general public, shareholders, and academia	Contact requests, demonstrations of interest

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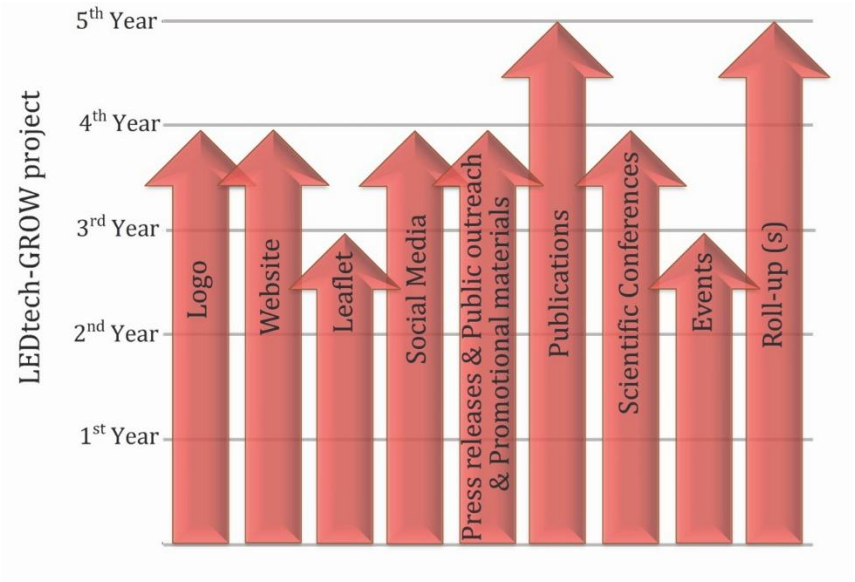

Figure 1. Roadmap of dissemination actions of LEDtech-GROW.

3. LEDtech-GROW Logo

The dedicated LEDtech-GROW logo (Figure 2) was launched during the early Project stage (D4.1, M1). A specific logo was designed to give the project a visual identity and is systematically used in all the project's promotional and dissemination activities, including our website, presentations, posters, communications, and documents.

The logo can be downloaded directly from the website or requested by contacting the project's principal investigator (Dr. Bojana Milićević) or data manager (TM5) (Katarina Milenković).

Figure 2. LEDtech-GROW project logo.

To ensure a consistent style, format, and identity for the project, template files for Microsoft PowerPoint and Word documents (Annex I) have been produced and will be utilized in all dissemination activities.

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4. Project Website

The dedicated LEDtech-GROW website (https://ledtechgrow-promis.org/, Figure 3) was launched during the early Project stage (D4.1, M2). The website serves as the main communication platform for LEDtech-GROW activities, providing basic information for the public and specific information for project stakeholders.

The website is of primary importance because of its expected impact on the target audiences. It primarily hosts public deliverables, brochures, posters, presentations, scientific papers, newsletters, magazine articles, videos, photos, and open-access scientific papers, among other materials. The project website will not include confidential deliverables, as the main exchange of such data will be among Project team members. It was designed to provide quick, simple, and useful information, serving as a dynamic and interactive tool to ensure clear communication and broad dissemination of project news, activities, and results.

The website is regularly updated with news and events related to the LEDtech-GROW Project. The LEDtech-GROW website will be live throughout the project and for at least a year after it ends. It is available in English.

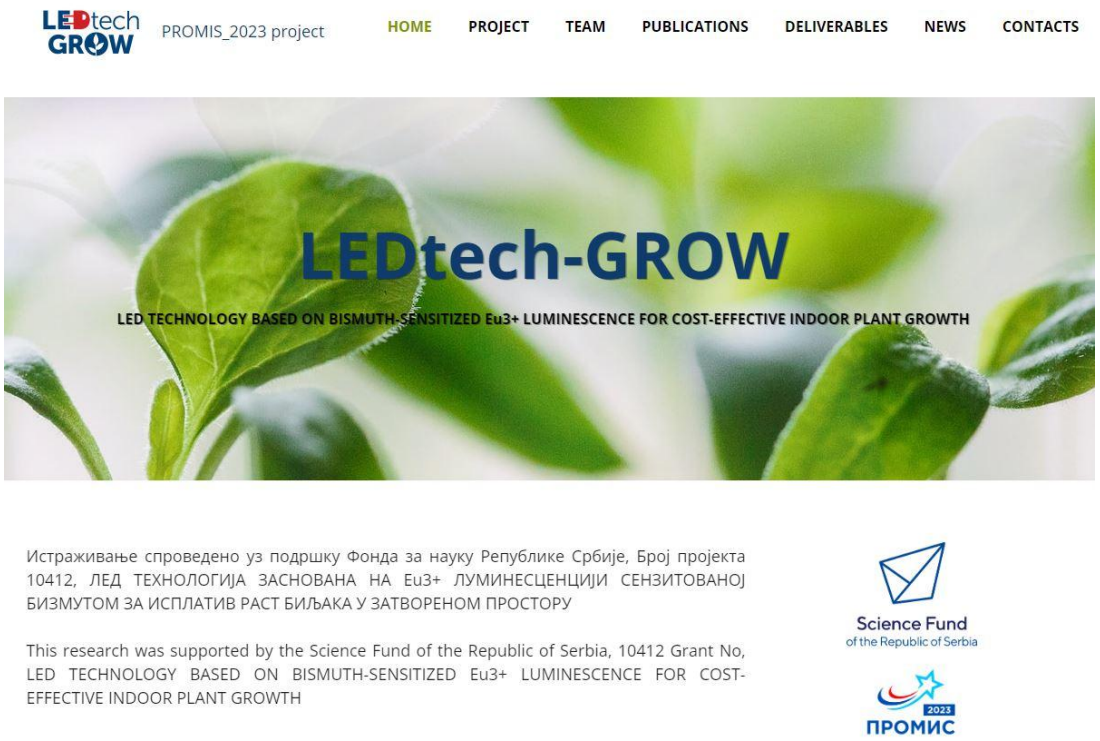

Figure 3. LEDtech-GROW project website.

The website was designed to reach a broad community, from scientists to the general public, interested in luminescence, nanomaterials, and LED technologies. Key features of the website include:

- **Homepage Overview** – This page offers a comprehensive overview of the project, detailing its objectives, the funding organization, and the key team members involved. It also provides links to our social media channels, specifically LinkedIn and Instagram, for progress updates. Additionally, contact information is available for any further inquiries or requests for information.

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- **Project Overview** – This page provides a comprehensive overview of the project, including its objectives and detailed descriptions of the work packages.
- **Team Overview** – This page introduces the LEDtech-GROW team members, highlighting their research positions, backgrounds, and areas of expertise.
- **Publication Overview** – This page includes publications related to the project and will be regularly updated.
- **Deliverable Overview** – This page includes deliverables along with direct links for easy access.
- **News Overview** – This page presents project outputs, news updates, newsletters, meetings, conferences, and events along with direct links for easy access.

  Contact Overview – This page presents the contact details of LEDtech-GROW for any further inquiries or requests for information.

Guidelines: The PI (also WP4 leader) hosts and manages the website, which is intended to be maintained for at least one year after the project's completion, or until the host considers it relevant and valuable. Commercial analytics applications may be used to monitor website visitors.

5. Leaflet

During the early Project stage (D4.1, M3), we crafted a triplet-format page (see Annex II) designed as an informative leaflet for distribution among partners. This leaflet will be used at various events, including scientific conferences, trade exhibitions, fairs, educational outreach in schools, and professional showcases. Its primary aim is to convey detailed information about the project's aims, execution strategies, and expected results to a broad audience.

This leaflet is crucial for enhancing project visibility among the general public. It provides context for the initiative, underscores its importance, and includes vital contact details and links to the project's official website. By presenting this information in an engaging and clear manner, we seek to captivate public interest and encourage involvement in the project's goals and activities. The leaflet must be available at all pertinent project events to maintain consistent communication and outreach.

Guidelines: The leaflet is available in both electronic and paper formats to ensure effective dissemination. A PDF version of the leaflet is available in a dedicated area of the project website (Deliverable page). The LEDtech-GROW leaflet will be disseminated at events and on social media to raise awareness and enthusiasm among the general public and stakeholders, including academic institutions and industry experts. This will facilitate easy access for partners, enabling them to share the material digitally and broaden its reach.

Significance of the Leaflet:

The leaflet functions as a promotional tool and a crucial element of our outreach strategy. By circulating this leaflet, we aim to enhance understanding of the project's influence and significance, fostering stakeholder dialogue and collaboration. It will also serve as a vital

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resource for addressing inquiries and clarifying the project's objectives and methodologies.

In summary, the active distribution of this leaflet will substantially elevate the profile of the LEDtech-GROW project. By engaging a diverse audience and delivering clear, accessible information, we can encourage wider participation and interest, ultimately contributing to the project's sustained success.

6. Social Media

LEDtech-GROW project is present on social media/networking *via* a dedicated LinkedIn (//www.linkedin.com/company/ledtech-grow?trk=public_post_follow-view-profile), and Instagram (//www.instagram.com/ledtech.grow?igsh=MTVueDM0Nzl0Z2VmNg==). The main purpose of using these social media is to reach wide visibility within the scientific community, institutional and industrial sectors.

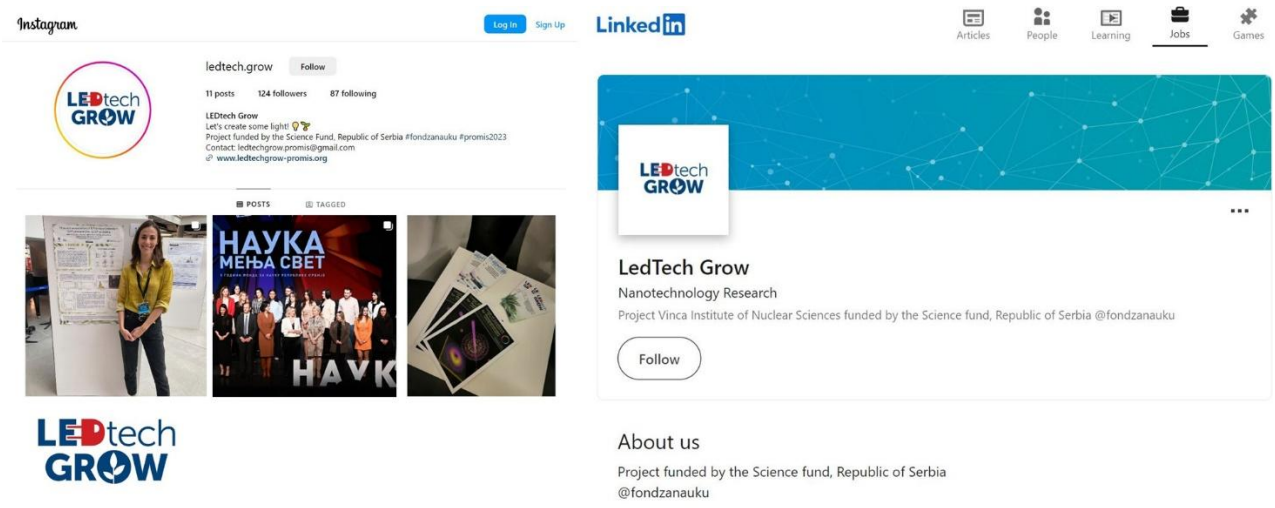

Figure 4. LEDtech-GROW on social media

Guidelines: WP4 has established all social media accounts, including LinkedIn and Instagram, to promote the project effectively. Team members are encouraged to share and forward relevant information, updates, and content that can enrich these channels. By contributing engaging posts, articles, and multimedia, team members can help increase visibility and foster a sense of community around the project.

7. Press Releases and Public Outreach

Project updates are shared regularly through multiple channels, including the project website, local newspapers, magazines, institutional social media, and more. Specific press releases will keep the general public and scientific or industrial communities updated about the project's goals and outcomes. This multi-channel approach maximizes visibility and engagement with diverse audiences.

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We also promoted public awareness of innovative LED technology for plant growth in indoor environments and its societal impact through various initiatives. For example, we participated in the 15th European Researchers' Night and the 66th International Fair of Techniques and Technical Achievements. These public outreach efforts are crucial for establishing future technological partnerships and advancing knowledge and science. Furthermore, an article outlining the main objectives of the LEDtech-GROV project (Annex III) was published in Movem magazine in May 2024 (//www.movem.rs/images/posts/pdf/movem-magazin-devetnesti-broj106.pdf).

Guidelines: WP4 drafts press releases for major events organized by team members. These press releases were uploaded to the website and disseminated through selected channels. When writing a press release, team members must follow a specific format that includes the date, an eye-catching headline, the LEDtech-GROW logo, the Science Fund emblem, and contact details for further inquiries.

8. Other Promotional Materials

Effective promotional materials for project dissemination, such as brochures, posters, or roll-up(s), are essential for several reasons. They raise awareness about the project, engage stakeholders, and communicate key findings and benefits. Well-designed materials capture attention, simplify complex information, and foster collaboration by inviting others to support the initiative. Finally, comprehensive distribution activities increase the project's impact and sustainability, ensuring valuable insights will reach a larger audience.

Additional promotional materials were developed as needed. For example, a poster presentation designed specifically for the youth population (Annex IV) was created for the 15th European Researchers' Night, held in Belgrade on September 27th, 2024.

Guidelines: Other promotional materials, such as posters and roll-ups, were used to showcase our project research at public meetings, fairs, and other events. Each material was tailored specifically for each event. This targeted approach enhanced audience engagement and effectively communicated our key messages, fostering greater awareness and collaboration around our project.

9. Scientific Publications and Peer-Reviewed Journals

The LEDtech-GROW's results were communicated to the scientific community mainly through publication in peer-reviewed journals. The target journals are fundamental and applied in the following areas: physics, chemistry, materials science, and nanotechnology, as well as in journals with an agricultural audience. The LEDtech-GROW followed the GA rules on open-access publications (Gold or Green). Open-access publications are available through the project website and deposited into the institutional repository (VinaR.vin.bg.ac.rs), while the research data were uploaded to the Zenodo.org repository, according to the Data Management Plan.

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To date, LEDtech-GROW team members have already submitted five scientific manuscripts (Annex V), and it is expected that scientific production will increase in the coming years.

Guidelines: All publications, all communications (posters, oral presentations in conferences), leaflets, and any other promotional material made by LEDtech-GROW scope have acknowledge the funding contribution of the Science Fund of the Republic of Serbia, using the following sentence: "This research was supported by the Science Fund of the Republic of Serbia, #GRANT No 10412, LED technology based on bismuth-sensitized Eu^{3+} luminescence for cost-effective indoor plant growth - LEDtech-GROW ."

10. Events

A crucial dissemination action was organizing or participating in events or meetings. The LEDtech-GROW team members participated in national and international meetings (targeting academic and industrial communities) to stay updated on developments in the field. Specialized events, such as scientific congresses, training events, and general public events (e.g., fairs, Researcher's Night), reached specialized audiences and provided good opportunities for knowledge exchange among scientists or industrial exhibitors. The main objective of congresses and training events was knowledge dissemination among the scientific community, while general public events or industrial events were more specific to target the general public and relevant stakeholders, respectively.

So far, LEDtech-GROW members have attended several international conferences, trainings, and general public events (see Annex VI). Our primary goal was to provide young scientists with not only significant knowledge and expertise in the LEDtech-GROW research areas, but also essential skills in Horizon project preparation, writing, and management, as well as important aspects of patent protection and intellectual property rights.

Guidelines: All team members are required to inform the principal investigator about their attendance at the event and provide details regarding their participation. An annual meeting has been held, allowing all team members to convene, review results, and strategize for the upcoming months of the project.

11. Exploitation Plan

Definition: Exploitation focuses on leveraging the project's results at various levels throughout and after its implementation. It involves key actions to increase the project's visibility, engage target groups, end-users, and stakeholders, and facilitate the integration of outcomes into their professional practices. A primary goal of exploitation is to encourage key actors to use the project's main products. Additionally, it plays a crucial role in ensuring the project's sustainability post-completion by promoting the effective use of results by the target audience and enabling their application in different contexts, such as other countries, educational or industrial sectors, or fields.

The LEDtech-GROW project focused on developing innovative inorganic nanophosphors for LED technologies, primarily targeting indoor farming and greenhouse applications, with a

significant societal impact. This initiative addresses key challenges in sustainable agriculture, enhancing plant growth and resource efficiency. The project has distinct exploitation interests, focusing on knowledge transfer to disseminate research findings effectively, while also committing to industrialization and commercialization to bring these innovations to market. A comprehensive exploitation strategy should be anticipated for how the main results, tools, or products can best be used and exploited within the field to which this project is intended.

The project members are the primary users of the project results, leveraging them through their initiatives or by facilitating others' exploitation, such as making results available under open licenses. Key activities to support this include innovation management, copyright management, developing data management plans, and engaging stakeholders and users. To achieve these goals, common tools may include patent publications, establishing spin-off or start-up companies, licensing practices (including open options), and using the results for academic purposes, such as in PhD research.

IPR Management: The LEDtech-GROW team participated in specialized IPR management training designed to empower members to pursue patents and protectable innovations. The training covered various aspects of IP, including the types and statuses of IP (both Background and Foreground) and different exploitation strategies, such as patents, licenses, and other protection mechanisms. Regular updates and discussions ensured that all team members are aligned on IP strategies and responsibilities.

Guidelines: IPR management includes analyses of the intellectual property that is needed or will be brought to the project (e.g., knowledge and inventions). Every team member is asked to report any exploitable foreground so that IP protection measures such as patents or trademarks can be implemented. For this purpose, reporting forms will be developed and made available upon reasonable request, but will not be available for download from the LEDtech-GROW website. In principle, these reports should contain the following information:

- Identification of specific contribution/role in the development
- Identification of IPR type
- Status of IPR: Exploitation Forms (type and owner) e.g., direct industrial use, patenting, technology transfer, license agreement, publications, standards, etc.
- Partner/s involved expectations
- Confidentiality (Yes/No)
- Innovativeness compared to already existing Products
- Competitive advantages
- Product Positioning Legal or normative or ethical requirements (need for authorizations, compliance to standards, norms, etc.)
- Cost of Implementation (before Exploitation)
- Sources of financing foreseen after the end of the project (for example other grants, etc.)

To maximize the commercial potential of their innovations, LEDtech-GROW team members may conduct a comprehensive market analysis if needed. This analysis will identify:

- *Target Market Size and Trends:* Understanding market demand, growth potential, and emerging trends in LED technologies for agriculture.
- *Potential Partners and Customers:* Identifying key stakeholders, including agricultural producers, greenhouse operators, and technology integrators who can benefit from these

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advancements.

- *Competitors and Competitive Advantages:* Analyzing existing competitors, their technologies, and positioning to determine how LEDtech-GROW's innovations can offer distinct advantages.

Indicators for Progress: To effectively monitor the implementation of the Exploitation Plan, the project will track several key indicators. These include participation in relevant industry events, such as conferences, trade shows, and fairs focused on agriculture and LED technologies, to build networks and promote project outcomes. Additionally, attendance at training and informational workshops will be measured to enhance knowledge and skills in commercialization strategies. Finally, the project will monitor potential patent applications and licensing agreements, as filed patents and established agreements may indicate successful intellectual property management.

Following the project's conclusion, LEDtech-GROW's results are expected to stimulate new collaborative research initiatives, particularly in LED applications for plant growth and sustainability. Continued engagement with industry stakeholders and researchers will be essential to fostering ongoing collaboration and enhancing the commercialization of the project's outcomes.

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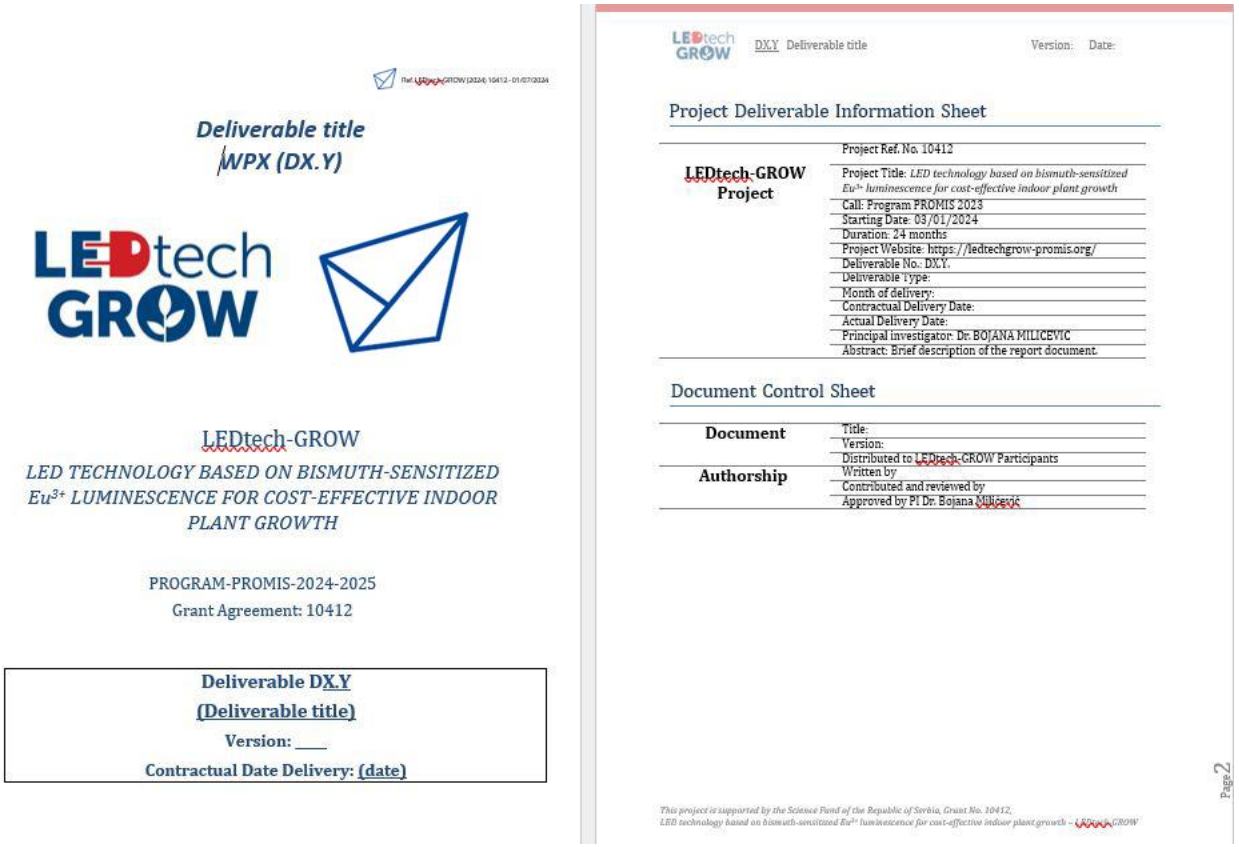
12. Annexes

Annex I

Microsoft Word (a) and Microsoft PowerPoint (b) documents created to be used in LEDtech-GROW Project



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	Approved by PI Dr. Bojana Milićević

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Page 2

a)

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https://ledtechgrow-promis.org/
ledtechgrow.promis@gmail.com

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ПРОМИС

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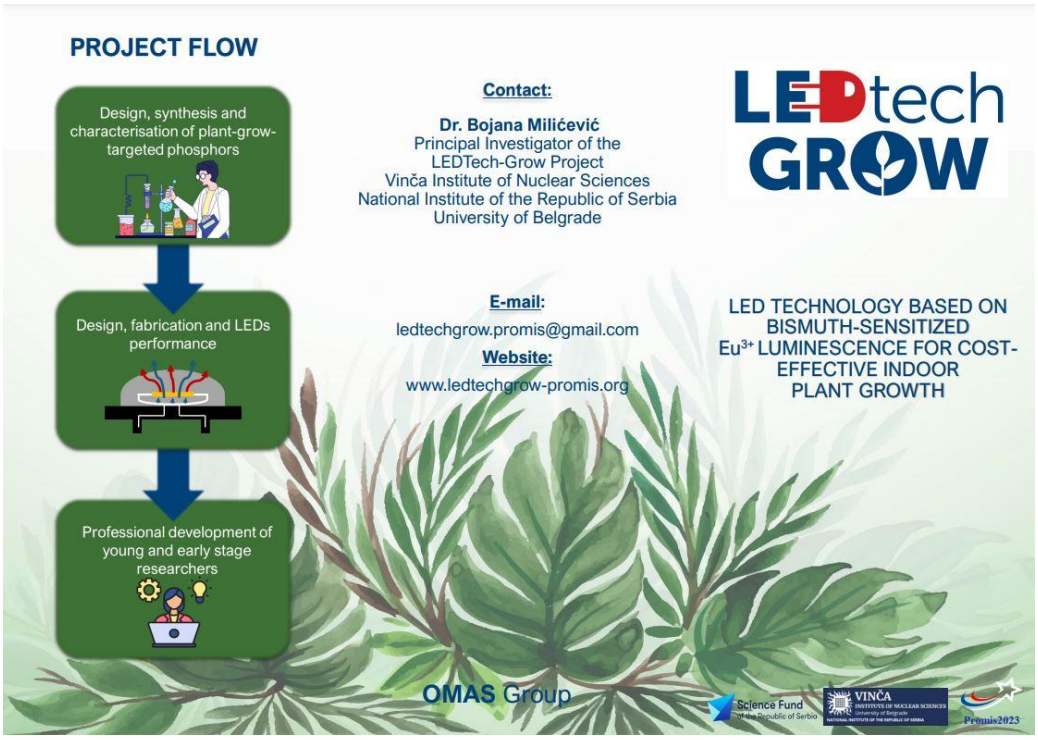
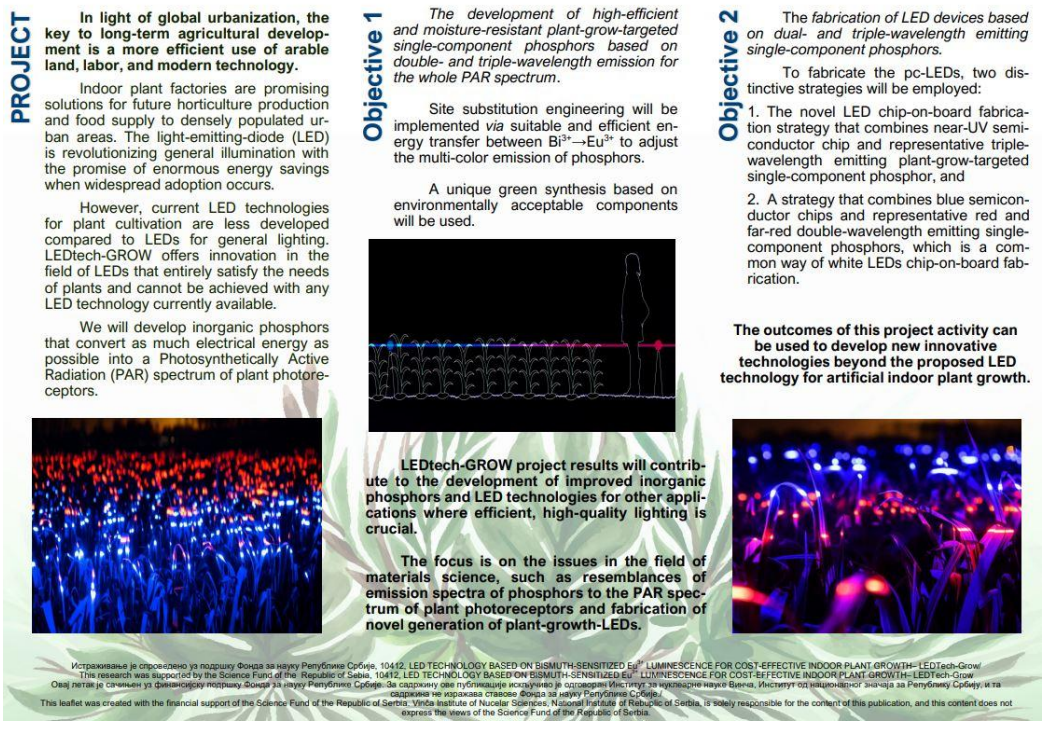
Annex II

Leaflet, deliverable D4.1 (WP4), April 2024





Annex III

Article published in Movem magazine, May 2024.

MLADE NAUČNICE IZ SRBIJE KOJE MENJAJU SVET

YOUNG FEMALE SCIENTISTS FROM SERBIA WHO CHANGE THE WORLD

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Fotografije / Photo KATARINA ŠOŠKIĆ
Lokacija / Location SMOKVICA

IMENA Bojana Milićević, Marina Stamenković i Jelena Vejin verovatno vam ne zvuče poznato. Creška, velika greškal (Da parafraziramo lik Vivijen iz kultnog filma „Zgodna žena" koju je interpretirala Džulija Roberts). A za to što smo odlučili da ih (više nego zasluženo) gurnemo pod reflektore zaslužan je Fond za nauku Republike Srbije koji nastavlja svoju predanost podršci mladih istraživača kroz Program za izvrsne projekte mladih istraživača i naučnika u ranoj fazi karijere – PROMIS 2023 u okviru kojeg će u naredne dve godine finansirati 30 projekata sa ukupnim budžetom od 4 miliona evra. Program PROMIS 2023 okuplja 156 naučnika iz 42 naučnoistraživačke organizacije u Srbiji. Ovi projekti ne samo da jačaju kapacitete mladih naučnika, već i grade temelje za njihovu budućnu konkurentnost na globalnom nivou doprinoseći razvoju nauke kako u Srbiji, tako i u svetu.

Odlučili smo da ove tri mlade naučnice, koje se pre ovoga nisu ni poznavale, okupimo na jednoj čajanci na kojoj su jedna drugoj pokušale da predstave projekte.

BOJANA, NA ŠTA SE ODNOSI TVOJ PROJEKAT, UKRATKO?

Bojana: U skladu sa stalnim rastom svetske populacije i sve manjom obradivom zemljištu, poljoprivreda se suočava sa izazovima koji zahtevaju inovativna rešenja. Upravo u tom kontekstu, projekat LED-Tech-GROW predstavlja tehnologiju koja koristi neorganske fosfore kako bi stvorila svetlost koja direktno doprinosi rastu biljaka, povećanju prinosa i očuvanju životne sredine.

THE NAMES of Bojana Milićević, Marina Stamenković and Jelena Vejin probably do not sound familiar to you. Big mistake. Big! (To paraphrase the character of Vivian interpreted by Julia Roberts in the iconic film "Pretty Woman"). And the fact that we decided to (more than deservedly) push them under the spotlight is due to the Science Fund of the Republic of Serbia, which continues to be dedicated to supporting young researchers through the Programme for Excellent Projects of Young Researchers and Scientists in the Early Stage of Career - PROMIS 2023, within which in the next two years, it will finance 30 projects with a total budget of 4 million euros. The PROMIS 2023 Programme brings together 156 scientists from 42 scientific research organisations in Serbia. These projects not only strengthen the capacities of young scientists, but also build the foundations for their future competitiveness at the global level, contributing to the development of science both in Serbia and in the world.

We decided to gather these three young scientists, who did not even know each other before this, at a tea party where they tried to present their projects to each other.

BOJANA, WHAT IS YOUR PROJECT ABOUT, IN A NUTSHELL?

Bojana: In accordance with the constant growth of the world's population and the decreasing amount of arable land, agriculture is facing challenges that require innovative solutions. It is in this context that the LED-Tech-GROW project presents a technology that uses inorganic phosphors to create light that directly contributes to plant growth, yield increase and environmental protection.

A ČIME SI SE TI BAVILA, JELENA?

Jelena: Većina proizvedenog poljoprivrednog otpada, transportuje se na deponije ili spaljuje na otvorenim mestima oslobađajući gasove staklene bašte u našu atmosferu tokom razlaganja. Kod nas u zemlji i regionu je često praksa da se spaljuju njive otvorenim plamenom, upravo u takvim i sličnim procesima se dobija biougalj – materijal koji se dobija od poljoprivrednih ostataka. Manji deo nastalog poljoprivrednog otpada se iskoristi u stočarstvu, za loženje, ili za proizvodnju brikata/peleta, a još manji deo se kompostira, podvrgava anaerobnoj digestiji (proizvodnja biogasa) ili pirolizi..

A TI, MARINA, U ŠTA SI SE TI UPUSTILA KROZ SVOJ PROJEKAT?

Marina: U sklopu projekta REDIRECT istraživački tim u Srbiji započeo je istraživanje procesa autofagije i njegovog potencijalnog uticaja na isporuku, transport i imunski odgovor prilikom primene RNK vakcine. Ovo istraživanje postavlja temelje za buduća istraživanja i konkurentnost zemlje u svetu istraživanja u ovom domenu. Istraživanje sprovodi tim sastavljen od stručnjaka iz Instituta za nuklearne nauke Vinča, Instituta za virusologiju, vakcine i serume „Torlak" i Fakulteta za fiziku hemiju.

Pored naučnog značaja, ovo istraživanje ima i širu društvenu korist. Informisanje javnosti o karakteristikama i sigurnosti ovih vakcina može doprineti povećanju obuhvata imunizacije, što je ključno za zaštitu najugroženijih kategorija, poput dece. Takođe, implementacija transfera RNK tehnologije koju su podržali Ministarstvo zdravlja i Svetska zdravstvene organizacije na Institutu za vakcine „Torlak" može imati pozitivne ekonomske aspekte za zemlju.

JELENA, ŠTA MOŽEMO STVARNO DA URADIMO KAKO BISMO KAO VRSTA DOPRINELI REŠENJU PROBLEMA GLOBALNOG ZAGREVANJA?

AND WHAT WERE YOU WORKING ON, JELENA?

Jelena: Most of the produced agricultural waste is transported to landfills or it is incinerated in open areas, releasing greenhouse gases into our atmosphere during decomposition. In our country and the region, it is a common practice to burn fields with an open flame, and it is precisely in such and similar processes that biochar is generated - material obtained from agricultural residues. A smaller part of the generated agricultural waste is used in animal husbandry, for burning, or for the production of briquettes/pellets, and an even smaller part is composted, subjected to anaerobic digestion (biogas production) or pyrolysis..

AND YOU, MARINA, WHAT DID YOU GET YOURSELF INVOLVED IN WITH YOUR PROJECT?"

Marina: As part of the REDIRECT project, the research team in Serbia started researching the process of autophagy and its potential impact on delivery, transport and immune response when applying an RNA vaccine. This research lays the foundation for some future researches and the country's competitiveness in the world of research in this domain. The research is carried out by a team of experts from the Institute of Nuclear Sciences in Vinča and the Institute of Virology, Vaccines and Sera "Torlak" and the Faculty of Physical Chemistry.

In addition to scientific importance, this research has wider social benefits. Informing the public about the characteristics and safety of these vaccines can contribute to increasing immunization coverage, which is crucial for the protection of the most vulnerable categories, such as children. Furthermore, the implementation of RNA technology transfer supported by the Ministry of Health and the World Health Organization at the "Torlak" Vaccine Institute can have positive economic aspects for the country.

Jelena: Ukoliko koristimo pirolizu da transformišemo otpad biomase u biougalj umesto da ga ostavimo po strani da se razgradi, ekološki problemi se mogu ublažiti dok se proizvode korisni materijali i energija. Piroliza je termičko razlaganje ugljeničnih materijala u okruženju bez kiseonika na visokim temperaturama, između 600 i 900 stepeni Celzijusa, a to nije isto što i sagorevanje ili spaljivanje.

Moje kolegинice i ja, kroz ovaj projekat, pokušaćemo da koristeći poljoprivredni otpad proizvedemo biougalj, da rad u laboratoriji optimizujemo na takav način da se što manje rastvarača koristiti u procesu proizvodnje i da na kraju tom biougљju damo dodatnu vrednost koristeći ga kao inovativni materijal u senzorici i određivanju pesticida u vodama. Ova istraživanja su ključna ne samo za razvoj senzorske tehnologije, već i za podizanje nivoa svesti o klimatskim promenama i održivom korišćenju resursa. Upotreba biougља može doprineti poboljšanju kvaliteta zemljišta, smanjenju emisije štetnih gasova i smanjenju upotrebe pesticida.

BOJANA, VERUJEM DA SE NEGDE I PREKLAPAMO U NAČINU NA KOJI RAZMIŠLJAMO O OVOJ PROBLEMATICI.

JELENA, WHAT CAN WE, AS A SPECIES, REALLY DO REGARDING OUR CONTRIBUTION TO THE GLOBAL WARMING PROBLEM?

Jelena: If we use pyrolysis to transform biomass waste into biochar instead of leaving it aside to decompose, environmental problems can be mitigated while producing useful materials and energy. Pyrolysis is the thermal decomposition of carbon materials in an oxygen-free environment at high temperatures, between 600 and 900 degrees Celsius, which is not the same as burning or incineration.

Through this project, my colleagues and I try to use agricultural waste to produce biochar, to optimize the work in the laboratory in such a way that as few solvents as possible are used in the production process, and in the end to give that biochar additional value by using it as an innovative material in sensor technology and determination of pesticides in water. These researches are crucial not only for the development of sensor technology, but also for raising awareness of climate change and sustainable use of resources. The use of biochar can contribute to improving the quality of the soil, reducing the emission of harmful gases and reducing the use of pesticides.

This project is supported by the Science Fund of the Republic of Serbia, Grant No. 10412,
LED technology based on bismuth-sensitized Eu^{3+} luminescence for cost-effective indoor plant growth – LEDtech-GROW

Bojana: Tako je. Jedinstvenost projekta LED-Tech-GROW leži u njegovom pristupu za osvetljenje u potpuno zatvorenom prostoru koristeći isključivo prirodnu svetlost koju emituju fosforni materijali. Ova tehnologija se pokazala izuzetno efikasnom, naročito u svetlu sve češćih klimatskih promena, suša i požara koji sve više ugrožavaju obradivo zemljište.

DRUGI KLJUČNI ELEMENT PROJEKTA JE NJEGOVA POTPUNA PRIRODNOST. NE KORISTE SE VEŠTAČKA ĐUBRIVA ILI HEMIKALIJE, VEĆ SE FOKUS STAVLJA NA STVARANJE OPTIMALNIH USLOVA ZA RAST BILJAKA,

BOJANA, I BELIEVE THAT WE SOMEHOW SHARE THE SAME VIEWS ABOUT THIS ISSUE?

Bojana: That's right. The uniqueness of the LED-Tech-GROW Project lies in its approach to lighting in a completely enclosed space, using only natural light emitted by phosphorus materials. This technology has proven to be extremely effective, especially in the light of increasingly frequent climate changes, droughts and fires that are increasingly threatening arable land.

ISKLJUČIVO UZ POMOĆ PRIRODNE SVETLOSTI. OVO NIJE SAMO EKOLOŠKI PRIHVATLJIV PRISTUP, VEĆ I EFIKASAN NAČIN DA SE OBEZBEDI DOVOLJNO HRANE ZA SVE VEĆI BROJ STANOVNIKA PLANETE.

Marina: Ako se ne varam, fosfor jeste prirodni element koji emituje svetlost. Ali kako ga možemo „izdresirati" tako da ta svetlost bude baš onakvih karakteristika koje su nam potrebne?

Bojana. Jedna od ključnih karakteristika fosfornih materijala koje se koriste u okviru ovog projekta jeste njihova sposobnost da emituju određenu boju svetlosti. Kroz analize istraživači su utvrdili da su crvena i plava boja najkorisnije biljkama jer ih apsorbuju hlorofil i drugi biljni fotoreceptori. To znači da biljke mogu efikasnije da apsorbuju svetlost i da brže rastu, što rezultira većim prinosima.

MARINA, NI PRED TOBOM NIJE LAK ZADATAK, ZAR NE?

Marina: Veoma je važno istaći da su vakcine koje proizilaze iz ovog istraživanja bezbedne. Rezultati studije

ANOTHER KEY ELEMENT OF THE PROJECT IS THE FACT IT IS COMPLETELY NATURAL, NO ARTIFICIAL FERTILIZERS OR CHEMICALS ARE USED, BUT THE FOCUS IS ON CREATING OPTIMAL CONDITIONS FOR PLANT GROWTH USING ONLY NATURAL LIGHT. THIS IS NOT ONLY AN ENVIRONMENTALLY FRIENDLY APPROACH, BUT ALSO AN EFFECTIVE WAY TO PROVIDE ENOUGH FOOD FOR THE EVER-INCREASING POPULATION IN OUR PLANET.

Marina: If I'm not mistaken, phosphorus is a natural element that emits light. But how can we "train" it so that light has exactly the properties we need?

Bojana: One of the key characteristics of the phosphorus materials used in this project is their ability to emit a certain colour of light. By conducting analyses, the researchers determined that red and blue are the most useful colours for plants, because they are absorbed by chlorophyll and other plant photoreceptors. This means plants can absorb light more efficiently and grow faster, resulting in higher yields.

biljaka, neorganski fosfori su veoma stabilni u spoljašnjim uslovima sa visokom vlagom, što ih čini idealnim za upotrebu u poljoprivredi. Ova tehnologija predstavlja pravi paradigmeni pomak u osvetljenju biljaka pružajući efikasno rešenje za buduće izazove u proizvodnji hrane. Promis projekt nije samo naučni poduhvat, već i praktično rešenje za sve veće izazove koje donosi rast svetske populacije. Uvođenjem ove tehnologije, možemo se nadati da ćemo osigurati dovoljno hrane za sve i očuvati našu planetu za buduće generacije.

ALI, PITANJE KOJE ČESTO MENI POSTAVLJAJU, A VERUJEM I VAMA DVEMA, JESTE KOLIKO SMO MI OVDE UOPŠTE RELEVANTNI NA NEKOM GLOBALNOM NIVOU?

Marina: Odgovoriću u svoje ime, ali verujem da se odnosi i na to čime se vas dve bavite. Moj projekat pod imenom REDIRECT predstavlja samo početak, već sada možemo zaključiti da Srbija ima svetlu naučnu budućnost i da će, zahvaljujući ovakvim projektima, biti konkurentna u globalnoj areni istraživanja.

AND THOSE ENVIRONMENTAL CHALLENGES REPRESENT AN ADDITIONAL MOTIVE FOR YOU, BOJANA, DON'T THEY?

Bojana: That's right. In addition to promoting plant growth, inorganic phosphorus is very stable in high humidity outdoor conditions, making it ideal for agricultural use. This technology represents a real paradigm shift in plant lighting, providing an efficient solution to future challenges in food production. The Promis Project is not only a scientific endeavour, but also a practical solution to the increasing challenges triggered by the growth of the world's population. By introducing this technology, we can hope to ensure enough food for everyone and preserve our planet for future generations.

BUT THE QUESTION THAT I AM OFTEN ASKED, AND I BELIEVE YOU TWO AS WELL, IS HOW RELEVANT ARE WE HERE ON A GLOBAL LEVEL?

Marina: I will answer on my own behalf, but I believe it also refers to what you two do. My project called REDIRECT is only the beginning, and we can already conclude now that Serbia has a bright scientific future and that, thanks to such projects, it will be competitive in the global research arena.

PROJEKAT LEDTECH-GROW: SVETLOSNA TRANSORMACIJA POLJOPRIVREDE

Dr Bojana Milićević radi u Centru izuzetnih vrednosti za konverziju svetlosne energije – CONVERSE, u Institutu za nuklearne nauke Vinča. Njen obrazovni put obuhvata doktorat iz fizičke hemije na Univerzitetu u Beogradu, kao i postdoktorske studije na Univerzitetu u Kini. Tokom studija u Kini, Bojana se posvetila istraživanju led dioda i fosfora, što je postavilo osnovu za projekat LEDtech-GROW u okviru programa PROMIS 2023, Fonda za nauku.

PROJEKAT REDIRECT: AUTOFAGIJA KAO KLJUČ ZA RNK VAKCINE

Dr Marina Stamenković dolazi sa Medicinskog fakulteta, Univerziteta u Beogradu gde je docent na Katedri za imunologiju i radi na Institutu za mikrobiologiji i imunologiju. Marina, zajedno sa svojim timom, sprovodi projekat REDIREKT u okviru programa PROMIS 2023, Fonda za nauku.

PROJEKAT ENVIROCHAR: BIOUGALJ KAO ODRŽIVO REŠENJE

Na Prirodno-matematičkom fakultetu Univerziteta u Novom Sadu, tim stručnjaka predvođen vanrednim profesorom dr Jelenom Beljin radi na projektu pod nazivom „EnviroChar", koji se fokusira na proizvodnju biouglja. Projekat će razviti odgovarajući biougalj u skladu sa zelenim principima i zelenom hemijom i primeniti ga u ekološkoj, analitičkoj i elektroanalitičkoj hemiji kao materijal za razvoj metoda za određivanje i uklanjanje postojanih organskih zagađivača iz vodene sredine.

LEDTECH-GROW PROJECT: LIGHT TRANSFORMATION OF AGRICULTURE

Dr. Bojana Milićević works at the Centre of Exceptional Values for the Conversion of Light Energy - CONVERSE, at the Institute of Nuclear Sciences in Vinča. Her educational path includes a PhD in physical chemistry at the University of Belgrade, as well as postdoctoral studies at a university in China. During her studies in China, Bojana devoted herself to the research of LEDs and phosphorus, which laid the foundation for the LEDtech-GROW Project within the PROMIS 2023 program of the Science Fund.

REDIRECT PROJECT: AUTOPHAGY AS THE KEY TO RNA VACCINES

Dr. Marina Stamenković comes from the Faculty of Medicine, University of Belgrade, where she is an assistant professor at the Department of Immunology and works at the Institute of Microbiology and Immunology. Marina, together with her team, implements the REDIRECT project within the PROMIS 2023 Programme of the Science Fund.

THE ENVIROCHAR PROJECT: BIOCHAR AS A SUSTAINABLE SOLUTION

At the Faculty of Science and Mathematics of the University of Novi Sad, a team of experts led by associate professor, Dr. Jelena Veljin, is working on a project called EnviroChar, which focuses on the production of biochar. The project will develop a suitable biochar in accordance with green principles and green chemistry and apply it in ecological, analytical and electroanalytical chemistry as a material for the development of methods determining and removing persistent organic pollutants from the aquatic environment.

This project is supported by the Science Fund of the Republic of Serbia, Grant No. 10412,
LED technology based on bismuth-sensitized Eu^{3+} luminescence for cost-effective indoor plant growth – LEDtech-GROW

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KLJUČ ZA DUGOROČNI RAZVOJ POLJOPRIVREDE

REVOLUCIJA U TEHNOLOGIJI LED RASVETE ZA UZGOJ BILJAKA

DR BOJANA MILIĆEVIĆ, VIŠI NAUČNI SARADNIK INSTITUTA ZA NUKLEARNE NAUKE „VINČA", UNIVERZITETA U BEOGRADU

U kontekstu globalne urbanizacije ključ za dugoročni razvoj poljoprivrede je efikasnije korišćenje obradivih površina, radne snage i moderne tehnologije. Zatvorene fabrike za uzgoj biljaka se sve više nameću kao obećavajuće rešenje u okviru moderne poljoprivrede i snabdevanja hranom gusto naseljenih urbanih područja. Revoluciju u oblasti rasvete predstavlja LED tehnologija koja pruža mogućnost ogromne uštede energije, međutim trenutne LED tehnologije za uzgoj biljaka nisu razvijene kao one za opštu rasvetu.

U Centru izuzetnih vrednosti za konverziju svetlosne energije – CONVERSE, u Institutu za nuklearne nauke Vinča, Institutu od nacionalnog značaja za Republiku Srbiju, Univerziteta u Beogradu, tim stručnjaka predvođen dr Bojanom Milićević radi na projektu pod nazivom „LED tehnologija zasnovana na Eu3+ luminescenciji senzitovanoj bizmutom za isplativ rast biljaka u zatvorenom prostoru - LEDtech-GROW", razvija savremenu i efikasnu LED rasvetu za uzgoj biljaka kao ključno rešenje za uspešnu buduću proizvodnju u zatvorenim uslovima.

Projekat LEDtech-GROW donosi inovacije u oblasti LED tehnologije, koje su specijalno prilagođene potrebama biljaka. LEDtech-GROW planira razvoj neorganskih materijala koji će efikasno pretvarati električnu u svetlosnu energiju koja je specifična za fotosintetske procese kod biljaka, što je različito od svetlosti potrebne za opštu rasvetu.

Kako LED svetla mogu spasiti poljoprivredu: novi pristupi za održivu proizvodnju hrane u uslovima rastuće urbanizacije

Prema procenama Organizacije za hranu i poljoprivredu Ujedinjenih nacija, očekuje se da će svetska populacija


Dr Bojana Milićević

u narednih 30 godina porasti za dve milijarde, sa trenutnih 7,7 milijardi na 9,7 milijardi do 2050. godine. Ovaj rast ima ozbiljne posledice na ravnotežu između rastuće populacije i obradivih površina. Prema trenutnim procenama, količina obradivih površina po osobi u svetu drastično opada, smanjujući se sa 0,38 hektara u 1970. godini na 0,23 hektara u 2000. godini, s predviđenim padom na samo 0,15 hektara po osobi do 2050. godine.

Poljoprivreda u 2050. godini trebalo bi da proizvede oko 50 odsto više hrane, stočne hrane i bioenergije nego u 2012. godini, kao i da snabdeva urbanizovana područja na isplativ način. Ključno pitanje je da li današnja poljoprivreda i snabdevanje hranom mogu zadovoljiti buduće potrebe uzimajući u obzir rastuće pritiske na već ograničene obradive površine, kao i intenziviranje negativnih posledica klimatskih promena.

Inovacije kao ključ za održivu poljoprivredu

Inovacije su neophodne ne samo za poboljšanje efikasnosti u pretvaranju dostupnih resursa u proizvod, već i za očuvanje ograničenih prirodnih resursa. Zatvorene fabrike za uzgoj biljaka sa veštačkom svetlošću predstavljaju obećavajuća rešenja za buduću poljoprivrednu proizvodnju. Trenutne strategije veštačke rasvete bazirane na plavim i crvenim LED svetlima imaju nedostatke kao što su odvojeno napajanje, nesklad u spektralnoj distribuciji i promena boje sa promenom snage. Stoga je kontrolisani LED izlaz koji odgovara spektru fotosintetskog aktivnog zračenja biljnih fotoreceptora neophodan u zatvorenim fabrikama i staklenicima zbog svog potencijala da poboljša prinos i ubrza procese rasta biljaka u odsustvu sunčeve svetlosti.

Napredak u razvoju neorganskih materijala za LED rasvetu

Naučni timovi se suočavaju sa značajnim izazovima u razvoju materijala koji se koriste za LED osvetljenje, s obzirom na potrebu za optimizacijom svetlosnog spektra koji stimuliše rast i razvoj biljaka. Istraživanja u ovoj oblasti su pokazala da neorganski materijali, kao što su aluminati, garneti i perovskiti, aktivirani četvorovalentnim jonima mangana pokazuju nisku kvantnu efikasnost (manje od 50 odsto) i široku emisiju u duboko-crvenim talasnim dužinama, što smanjuje efikasnost LED svetala i ne zadovoljava spektralne zahteve biljaka. Sa druge strane, fluoridni materijali aktivirani jonima mangana su pokazali značajno veću kvantnu efikasnost, međutim, njihova sinteza je izuzetno opasna, a nedostatak duboke-crvene emisije ne može dovoljno stimulisati fitohromne fotoreceptore biljaka. Takođe, poznato je da fluoridni materijali aktivirani jonima mangana nisu stabilni u vlažnim okruženjima, kao što su staklenici i zatvorene fabrike za uzgoj biljaka, zbog njihove sklonosti ka hidrolizi i stvaranju mangan-oksida i hidroksida. Kao rešenje, istraživači se okreću materijalima

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LED technology based on bismuth-sensitized Eu^{3+} luminescence for cost-effective indoor plant growth – LEDtech-GROW

aktiviranim trovalentnim jonima europijuma koji nude visoku stabilnost, efikasnost i uske crvene i narandžaste emisione linije, dok u specifičnim slučajevima može doći i do emisije intenzivne duboko-crvene svetlosti koja je neophodna za razvoj biljaka u zatvorenim fabrikama i staklenicima. Nedavne studije su pokazale da se može ostvariti do 20 odsto uštede energije za bele LED diode korišćenjem europijum-aktiviranih nanočestica.

LEDtech-GROW projekat ima za cilj razvoj materijala na nano i submikronskoj skali sa preciznom kontrolom optičkih svojstava putem prenosa energije, što otvara brojne mogućnosti za sledeću generaciju LED svetala specijalizovanih za uzgoj biljaka. Ova tehnologija koristi plave emitere – jone bizmuta, kao i crveno i duboko-crvene emitere – jone europijuma, omogućavajući optimalnu ravnotežu između apsorpcije, emisije i prilagodljivosti spektralnog oblika, pokrivajući ceo spektar fotosintetski aktivnog zračenja biljnih fotoreceptora. Neorganski materijali koji kombinuju plavu emisiju koja potiče od jona bizmuta sa jedinstvenom crvenom i dubokom crvenom emisijom jona europijuma povećavaju svetlosni izlaz za fotoreceptore, kao što su kriptohromi i fitohromi, dok istovremeno obezbeđuju visoki kvalitet boje. Da bi se postigla optimalna višebojna emisija materijala neophodan je i efikasan prenos energije između jona bizmuta i europijuma.

Materijali koji su pažljivo odabrani pokazuju snažnu emisiju zbog visoke koncentracije aktivatorskog jona, otpornost na vlagu, što je od suštinskog značaja u zatvorenim fabrikama i staklenicima zbog visokih vlažnosti u kojima funkcionišu, i precizno usklađivanje sa fotosintetski aktivnim spektrom zračenja, što je ključno za kontrolu biljnih metaboličkih procesa, rasta, cvetanja i količine biljnih prinosa.

Poboljšanje efikasnosti i stabilnosti svetlosnih izvora u vlažnim i zahtevnim uslovima

Tradicionalna LED rasveta koristi poluprovodničke čipove na bazi galijum ili galijum-indijum nitrida u kombinaciji sa neorganskim materijalima za konverziju svetlosti, što omogućava proizvodnju vidljive svetlosti. Pomenuti materijali apsorbuju deo plave ili bliske ultraljubičaste svetlosti i emituju svetlost na većim talasnim dužinama. Najčešće, za proizvodnju belih LED svetala koristi se plavi poluprovodnički čip, žuti i crveno emitujući neorganski materijali. Sličan pristup se koristi i za proizvodnju LED svetala namenjenih uzgoju biljaka. Međutim, prilikom upotrebe LED svetala pobuđenih plavim čipovima može doći do neslaganja u bojama što dalje može uticati na efikasnost rasvete za biljke.

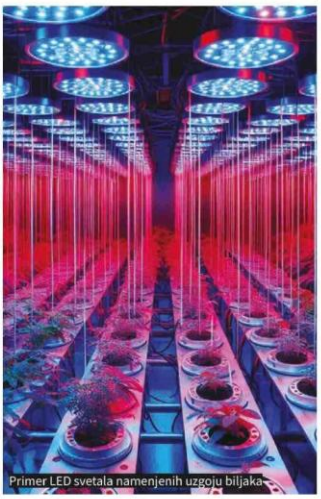
Istraživanja u okviru LEDtech-GROW projekta obuhvataju kombinovanje poluprovodničkog čipa baziranog na bliskom ultraljubičastom svetlu i neorganskih materijala aktiviranih jonima bizmuta i europijuma koji emituju plavu, crvenu i duboko-crvenu svetlost, a koji su sintetisani u našoj laboratoriji. Plava emisija stimuliše fotoreceptore kao što su kriptohromi i fototropin, uska crvena i duboko-crvena emisija fitohromne fotoreceptore, dok se celokupna emitovana svetlost poklapa sa apsorpcionim spektrom hlorolofila a i b. Korišćenjem ove tehnologije i sam čip emituje male količine bliske ultraljubičaste svetlosti koja može stimulisati pterin fotoreceptor i poboljšati cirkadijalni ritam i fototropizam biljaka.

Uticaj na održivu poljoprivredu i bezbednost hrane

LEDtech-GROW nudi rešenja u pogledu dizajniranja LED svetla koja direktno utiču na ubrzani razvoj biljaka i povećanje njihovog prinosa u zatvorenim fabrikama i staklenicima. Usled klimatskih promena, kao što su rastuće temperature i sve učestalije suše, požari i invazije štetočina, dolazi do gubitka biljnih vrsta i povećane potražnje za hranom. Naš projekat radi na razvoju LED tehnologije čiji je potencijal da obezbedi neometan razvoj biljaka u zatvorenim sistemima, smanjenje potreba za pesticidima i đubrivima, kao i izloženost radnika opasnim hemijskim agensima. Ujedno, manja potrošnja vode i hemikalija u proizvodnji hrane takođe doprinosi očuvanju životne sredine i poboljšanju nutritivnog kvaliteta i bezbednosti hrane.

Projekat LEDtech-GROW, finansiran kroz Program PROMIS 2023 Fonda za nauku Republike Srbije, predstavlja značajan iskorak u modernizaciji poljoprivrede i očuvanju životne sredine. Ovaj inovativni projekat fokusira se na napredne aspekte nauke o materijalima, istražujući kako se emisioni spektri sintetisanih neorganskih materijala usklađuju sa fotosintetski aktivnim zračenjem biljnih fotoreceptora, te na razvoj nove generacije LED svetala koja su posebno dizajnirana za poboljšanje rasta biljaka u odsustvu sunčeve svetlosti. U budućnosti, naš rad će se usmeriti na unapređenje metoda uzgoja biljaka i sveobuhvatno praćenje njihovog razvoja.

Planiramo da istražimo nove pristupe u tehnologiji uzgoja, uključujući optimizaciju uslova rasta, poboljšanje hranljivih materija i primenu naprednih tehnika za kontrolu okoline. Naša nastojanja će uključivati saradnju sa stručnjacima iz različitih oblasti, uključujući agronome, biotehnologe i inženjere, kako bismo integrisali najnovija saznanja i tehnologije u naš rad. Cilj nam je da stvorimo efikasne i održive metode uzgoja koje će omogućiti bolje rezultate u poljoprivredi i doprineti ukupnom poboljšanju proizvodnje hrane, čime ćemo dodatno podržati održivu poljoprivredu i zaštitu životne sredine. ■



Primer LED svetala namenjenih uzgoju biljaka

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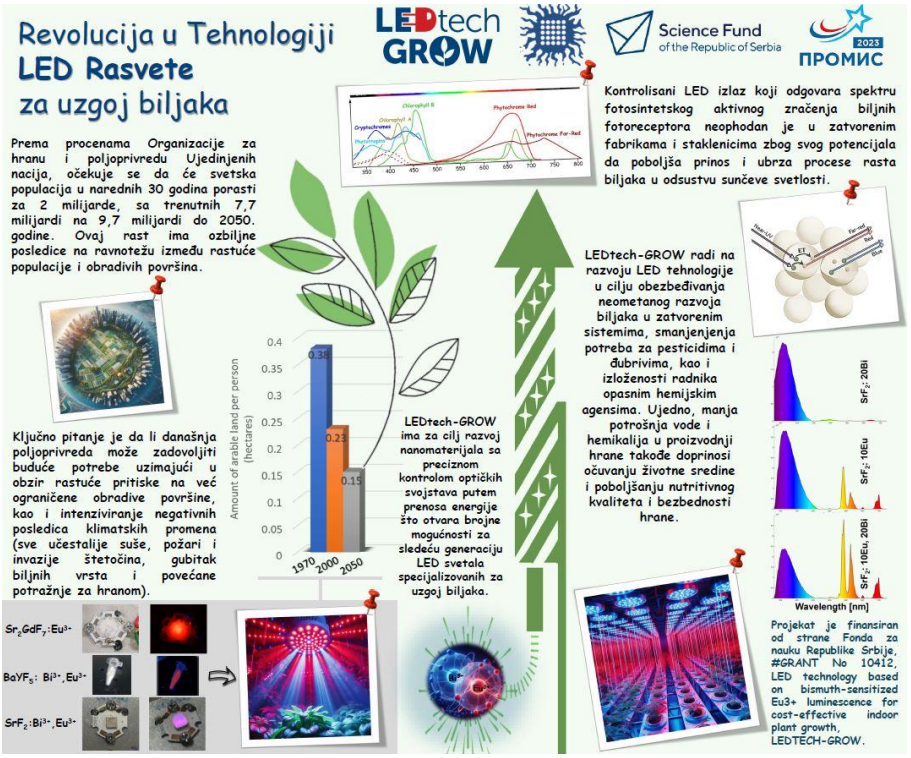
Annex IV

Poster presentation for the youth population at the 15th European Researchers' Night, September 2024.



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Annex V

List of scientific publications – to be updated regularly in the DCE Plan and LEDtech-GROW Website

No.	AUTHORS	ARTICLE TITLE	JOURNAL	STATUS
1.	**Bojana Milićević**, **Aleksandar Ćirić**, Zoran Ristić, Mina Medić, Abdullah N. Alodhayb, Ivana Radosavljević Evans, Željka Antić, Miroslav D. Dramićanin	**Eu^{3+}- activated Sr_2GdF_7 colloid and nano-powder for biomarker and horticulture LED**	Journal of Alloys and Compounds (M21a)	Accepted
2.	**Katarina Milenković, Ljubica Đačanin Far, Sanja Kuzman,** Željka Antić**, Aleksandar Ćirić,** Miroslav D. Dramićanin**, Bojana Milićević**	**Red emission enhancement in $BaYF_5:Eu^{3+}$ phosphor nanoparticles by Bi^{3+} co-doping**	Optics Express (M21)	Accepted
3.	**Jovana Periša, Sanja Kuzman, Aleksandar Ćirić, Zoran Ristić,** Željka Antić, Miroslav Dramićanin, **Bojana Milićević**	**Tunable red and blue emission of Bi^{3+}-co-doped $SrF_2:Eu^{3+}$ nanophosphors for agricultural LEDs**	Nanomaterials (M21)	Accepted
4.	**Bojana Milićević**, **Aleksandar Ćirić**, **Katarina Milenković**, Zoran Ristić, Jovana Periša, Željka Antić, Miroslav D. Dramićanin	**Pr^{3+}-Activated Sr_2LaF_7 Nanoparticles as a Single-Phase White-Light-Emitting Nanophosphor**	Nanomaterials (M21)	Accepted
5.	**Ljubica Đačanin Far**, **Jovana Periša**, Ivana Zeković, Zoran Ristić, Mina Medić, Miroslav D. Dramićanin, **Bojana Milićević**	**Tailoring red and deep-red light: Bi^{3+} doped $Sr_2Gd_{0.2}Eu_{0.8}F_7$ phosphors for next-generation horticultural LEDs**	Results in Physics (M21)	Accepted
6.	**Ljubica Đačanin Far**, **Jovana Periša**, Zoran Ristić, Anatolijs Šarakovskis, Vladimir Pankratov, Abdullah Alodhayb, Lukasz Marciniak, **Sanja Kuzman**, Miroslav D. Dramićanin, **Bojana Milićević**	**Eu^{3+}-Doped Sr_2LaF_7 Nanopowders as Efficient Red and Deep-Red Emitters for Advanced Horticultural Lighting**	Progress in Theoretical and Experimental Physics (M21)	Submitted
7.	**Aleksandar Ćirić,** Markus Suta, Tom Förster, **Bojana Milićević,** Tamara Gavrilović, Željka Antić, Miroslav Dramićanin	**Algorithm for Judd-Ofelt analysis of Pr^{3+} from the emission spectrum: case study of $Sr_2LaF_7:Pr^{3+}$ nano-powder**	Advanced Optical Materials (M21a)	Submitted

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Annex VI

List of Poster presentations at scientific congresses – to be updated regularly in the DCE Plan and LEDtech-GROW Website

No.	AUTHORS	PRESENTATION TITLE	CONGRESS	DATE	PLACE
1.	**Katarina Milenković**, Vesna Đorđević, Sanja Kuzman, Jovana Periša, Bojana Milićević, Miroslav D. Dramićanin	**Three-fold enhancement of Eu^{3+} emission intensity in $BaYF_5$ nanoparticles by Bi^{3+} co-doping**	12th International Conference on Luminescent Detectors and Transformers of Ionizing Radiation (https://www.cfi.lu.lv/en/lumdetr2024/)	June 16-21, 2024	Riga, Latvia
2.	**Bojana Milićević**, Aleksandar Ćirić, Zoran Ristić, Mina Medić, Ivana Radosavljevic Evans, Željka Antić, Miroslav D. Dramićanin	**Synthesis, luminescent properties, and thermal stability of Eu^{3+}-doped Sr_2GdF_7 red-emitting nanophosphor for horticulture LEDs**	The 7th International Conference on the Physics of Optical Materials and Devices & The 4th International Conference on Phosphor Thermometry (https://icomonline.org/)	August 26-30, 2024	Bečići, Budva, Montenegro
3.	**Sanja Kuzman**, Bojana Milićević, Jovana Periša, Aleksandar Ćirić, Zoran Ristić, Željka Antić, Miroslav	**Synthesis and photoluminescent properties of Bi^{3+}-codoped $SrF_2:Eu^{3+}$ phosphor nanoparticles**	The 7th International Conference on the Physics of Optical Materials and Devices & The 4th International Conference on Phosphor Thermometry (https://icomonline.org/)	August 26-30, 2024	Bečići, Budva, Montenegro
4.	**Katarina Milenković**, Vesna Đorđević, Ivana Zeković, Zoran Ristić, Jovana Periša, Bojana Milićević, Miroslav D. Dramićanin	**Microwave-assisted solvothermal method for RbY_3F_{10} doped with Eu^{3+}**	The 7th International Conference on the Physics of Optical Materials and Devices & The 4th International Conference on Phosphor Thermometry (https://icomonline.org/)	August 26-30, 2024	Bečići, Budva, Montenegro
5.	**Ljubica Đačanin Far**, Bojana Milićević, Jovana Periša, Aleksandar Ćirić, Katarina Milenković, Sanja Kuzman, and Miroslav D. Dramićanin	**Eu^{3+}-Doped Sr_2LaF_7 nanopowders for Indoor Plant Growth LED Applications**	6th International Conference on MATERIALS SCIENCE & NANOTECHNOLOGY Future Materials 2025 (https://materialsconference.yuktan.com/poster-presenters)	October 27-30, 2025	Tenerife, Spain (pp 119-120).

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6.	**Sanja Kuzman**, Ljubica Đačanin Far, Bojana Milićević, Jovana Periša, Aleksandar Ćirić, Katarina Milenković, and Miroslav D. Dramićanin	**Emission Enhancement by Bi^{3+} Co-Doping of Red-Emitting nanophosphor for Horticulture LEDs**	6th International Conference on MATERIALS SCIENCE & NANOTECHNOLOGY Future Materials 2025 (https://materialsconference.yuktan.com/poster-presenters)	October 27-30, 2025	Tenerife, Spain (pp 121).

List of Invited and Oral presentations at scientific congresses – to be updated regularly in the DCE Plan and LEDtech-GROW Website

No.	AUTHORS	PRESENTATION TITLE	CONGRESS	DATE	PLACE
1.	**Sanja Kuzman**, Bojana Milićević, Katarina Milenković, Jovana Periša, Miroslav D. Dramićanin (Invited talk)	**Bismuth-Sensitized Eu^{3+} Luminescent LED Technology for Effective Indoor Plant Growth**	The 3rd Serbian Conference on Materials Application and Technology – SCOM2024 (https://www.razvojnauke.org/)	October 16-18, 2024	Belgrade, Serbia
2.	**Aleksandar Ćirić**, Markus Suta, Bojana Milićević, Tom Förster, Tamara Gavrilović, Željkiroslav Antić, M. D. Dramićanin (*Oral talk)*	**Judd-Ofelt Analysis of Pr^{3+}: A Direct Emission Spectrum Approach for Advanced LED Phosphors and Scintillators**	6th International Conference on MATERIALS SCIENCE & NANOTECHNOLOGY Future Materials 2025 (https://materialsconference.yuktan.com/featured-speakers)	October 27-30, 2025	Tenerife, Španija (pp 35)

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List of general public events

No.	ATTENDEE	PRESENTATION	EVENTS	DATE	PLACE
1.	Bojana Milićević Jovana Periša	**Principal investigators of 30 projects supported under the PROMIS 2023 program were presented at the ceremony**	The Science Fund celebrated 5 years since its establishment (https://fondzanauku.gov.rs/2024/03/fond-za-nauku-svecano-obelezio-5-godina-od-osnivanja/)	March 20, 2024	Belgrade, Serbia
2.	Jovana Periša	**Leaflet and promotional material**	The 66th International Fair of Techniques and Technical Achievements	March 21-24, 2024	Belgrade, Serbia
3.	Bojana Milićević, Sanja Kuzman	**Revolutionizing LED technology for plant growth**	15th European Researchers' Night, (https://nocistrazivaca.rs/radionice_i_programi/ledtech-grow/)	September 27, 2024	Belgrade, Serbia

List of training events

No.	TRAINING ATTENDEE	TRAINING TITLE	TRAINING ORGANIZED	DATE	PLACE
1.	All team members	**How to make the best use of unfunded project proposals?**	Marija Šola Spasić, coordinator of Management Office projects at Vinca Institute for Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade	February 6, 2024	Online
2.	Ljubica Đačanin Far, Bojana Milićević	**Training for preparing, writing, and managing Horizon projects**	The European Training Academy (EUTA)	February 22, February 23, February 27, March 1, 2024	Belgrade, Serbia
3.	All team members	**Protection of Trade Secrets**	The Intellectual Property Office of the Republic of Serbia (Lecturer: Aleksandra Mihailović, Asst. Director)	March 5, 2024	Online

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4.	All team members	**Introduction to Patents**	The Intellectual Property Office of the Republic of Serbia (Lecturer: Nataša Milovanović, Head of the Department for Mechanical Engineering, Electrotechnics and General Technology)	March 12, 2024	Online
5.	All team members	**International Protection of Inventions**	The Intellectual Property Office of the Republic of Serbia (Lecturer: Aleksandra Mihailović, Asst. Director)	March 19, 2024	Online
6.	All team members	**Software protection with a patent**	The Intellectual Property Office of the Republic of Serbia (Lecturer: Nataša Milovanović, Head of the Department for Mechanical Engineering, Electrotechnics and General Technology)	March 26, 2024	Online
7.	All team members	**Compiling an application for the protection of an invention**	The Intellectual Property Office of the Republic of Serbia (Lecturer: Jelena Tomić Keser, Head of the Department for Chemistry and Chemical Technology)	April 2, 2024	Online
8.	Bojana Milićević, Sanja Kuzman	**LEDtech-GROW**	The European Researchers' Night, Faculty of Physical Chemistry, Belgrade, Serbia	September 28, 2024	Online
9.	Bojana Milićević, Sanja Kuzman, Jovana Periša	**Excel Masterclass**	Aleksandar Grašić	October 3, 2024	Online
10.	All team members	**Introduction to JADE®**	International Centre for Diffraction Data (ICDD)	April 23, 2025	Online
11.	All team members	**Open Science and Obligations for Participants in the Science Fund of the Republic of Serbia Program**	Vinča Institute for Nuclear Sciences, University of Belgrade	May 13, 2025	Belgrade, Serbia
12.	Ljubica Đačanin Far, Jovana Periša, Katarina Milenković	**Horizon Europe Info Days – WIDERA Work**	European Commission	May 20	Online

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		Programme 2025			
13.	Bojana Milićević, Sanja Kuzman, Aleksandar Ćirić	**Horizon Europe Info Days – Cluster 6: Food, Bioeconomy, Natural Resources, Agriculture and Environment**	European Commission	May 20, 2025	Online
14.	All team members	**Powder X-ray Diffraction – Better Data Equals Better Results**	International Centre for Diffraction Data (ICDD)	May 21, 2025	Online
15.	All team members	**The ICDD Raman File: Design, Content and Applications**	International Centre for Diffraction Data (ICDD)	June 25, 2025	Online

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