

VOL. 6



RELIANCE

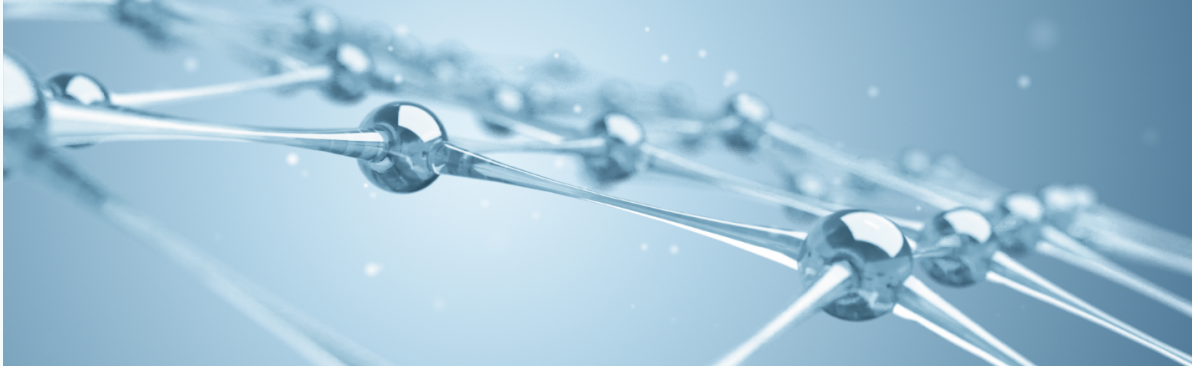
10 July 2026

Newsletter

Smart response self-disinfected **bio-based**
nanocoated surfaces for **healthier** environments

RELIANCE project aims to design and develop smart response self-disinfectant antimicrobial nanocoatings based on a new range of smart antimicrobial nanoparticles. They will consist of mesoporous silica nanoparticles with metallic copper in their structure (Cu-SMIN), modified with biobased bioactive compounds: Antimicrobial peptides (AMP's) based on protein containing waste streams, and essential oils (EOs) coming from non-edible plants. The antibacterial action of these additives will be adjusted to the specific application, according to the dosages and durability requirements.

**ADVANCING SAFER SURFACES THROUGH SMART
MATERIALS: RELIANCE AT THE FINISH LINE**



As RELIANCE approaches the end of its journey, we reflect on four years of intense research, collaboration and innovation driven by one central mission: making surfaces safer through advanced antimicrobial materials. From the earliest stages of nanoparticle design to a final portfolio of validated technologies, industrial prototypes, socio-economic insights and a strong network of partners, the project has consistently pushed the boundaries of what smart-response antimicrobial innovation can achieve.

In this final year, RELIANCE's technologies matured into **validated prototypes, semi-industrial scale formulations** and **evidence-backed antimicrobial solutions** designed to support cleaner environments across healthcare, home appliances and public spaces. Our Cu-MSN nanoparticles, enhanced with essential oils and antimicrobial peptides, demonstrated strong antibacterial, antifungal and antiviral performance, while remaining aligned with Europe's Safe-and-Sustainable-by-Design principles.

The project's closing phase marked important milestones:

- Demonstration of RELIANCE nanocoatings in real operational environments
- Completion of socio-economic and environmental impact assessments
- Final exploitation strategy and business plans for Key Exploitable Results
- The launch of the RELIANCE Final Project Video - a comic-style story explaining our complex scientific outputs in an accessible and engaging

- A successful Final Conference where partners, stakeholders and experts gathered to showcase results, discuss exploitation pathways and align scientific innovation with policy regulations, market readiness and opportunities for future collaboration.

RELIANCE now stands as a good example of how advanced materials research can contribute to safer, healthier and more resilient societies. Although the project formally ends, its technologies, knowledge base and partnerships will continue to support innovation in the field of antimicrobial materials and sustainable surface protection.

Thank you for following our work through the journey. Enjoy this final issue of the RELIANCE newsletter and visit our website for more updates on results:

reliance-he.eu/

WHAT WE HAVE BEEN UP TO

RELIANCE Consortium Gathers in Ghent for a Productive Meeting on Project Progress



Last summer, RELIANCE partners met in Ghent for a two-day meeting hosted by *Centexbel*, reviewing progress across all work packages and aligning the final steps towards project completion during the remaining year. Technical highlights included:

- Advanced textile validation for medical and pharmaceutical protective clothing
- Two new families of antimicrobial additives:
 - **Smart-released Cu-MSN with essential oils**
 - **Cu-MSN with antimicrobial peptides (AMPs)**
- Strong antiviral and antibacterial results

Besides presentations and work activities, the event included an interesting, guided tour of Centexbel's facilities and a cultural visit through historic Ghent.

[Continue reading...](#)

Launching the final RELIANCE video



After four years of research, collaboration and innovation, RELIANCE is leaving behind validated results for safer, smarter and more sustainable antimicrobial surfaces.

Our final animated video takes you through our journey - from the challenge of conventional antimicrobial technologies to the innovative solutions and application areas demonstrated within the project.

Click on the image to watch the video and discover how the project results contribute to the next generation of self-disinfecting surfaces designed for real-world impact and industry uptake.

PROMOTING MARKET UPTAKE



Technical info sheets of 6 Key Exploitable Results

RELIANCE has successfully designed, developed and validated a new generation of smart-response, self-disinfecting, sustainable antimicrobial nanocoating solutions addressing the growing industrial and societal demand for safer, more durable and environmentally responsible surface technologies. By combining bio-based active agents, controlled-release nanostructures and application-specific coating deposition technologies, the project has delivered a coherent innovation pipeline spanning materials development, formulation, validation and end-use integration.

On our website, we presented the **six Key Exploitable Results (KERs)** with the strongest market potential upon project's conclusion in August 2026.

Each info sheet includes the name of the result, the challenge it addresses, the solution it provides, key benefits, application areas, TRL level and information regarding safety and sustainability.

Copper-Doped Mesoporous Silica Nanoparticles with Essential Oils for Smart Antimicrobial Coatings

A long-lasting, safe and sustainable antimicrobial additive enabling next-generation protective coatings



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  Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Health and Digital Executive Agency (HDDEA). Neither the European Union nor the granting authority can be held responsible for them.

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Challenge Addressed
Conventional antimicrobial additives used in coatings, plastics and textiles often rely on high concentrations of metal ions or toxic biocides. These solutions raise growing concerns related to human health, environmental persistence, regulatory compliance and antimicrobial resistance, while also increasing formulation costs and limiting long-term effectiveness.

The Solution
An innovative antimicrobial technology based on copper-doped mesoporous silica nanoparticles (Cu-MSN) loaded with natural essential oils. The proper functionalization of the mesoporous structure make it acting as a smart carrier that enables the controlled, sustained release of bioactive compounds upon pH and T variation, ensuring long-lasting antimicrobial performance while minimizing the amount of active substances required.

Key Benefits

Durable antimicrobial effectiveness, making it cost-efficient even for large-scale applications.	Scalable synthesis supports industrial uptake and regulatory readiness.
Combines copper with natural bioactives to reduce toxicity, limit environmental impact and lower the risk of antimicrobial resistance.	Easily integrated into existing coating formulations , allowing industrial users across multiple sectors to upgrade antimicrobial performance without changing their production processes.

Application Areas

- Commercialised as an ingredient or as part of a ready-to-use formulation, offering flexibility across the value chain.
- Home appliance coatings (refrigerators and washing machines)
- Healthcare (hospital surfaces, protective and functional textiles)
- Consumer electronics and high-contact public surfaces

Validation - TRL 5
Validated in relevant industrial environments, including home appliance and textile substrates. Testing includes durability, antimicrobial efficacy & compatibility with industrial processes, supported by electrochemical validation methods.

Sustainability & Safety
The technology follows Safe-by-Design principles and aligns with EU sustainability and chemical safety regulations. By combining low-dose copper with natural essential oils and a controlled-release mechanism, Cu-MSN minimizes environmental emissions, supports regulatory compliance and contributes to safer, longer-lasting antimicrobial solutions.

A natural, safe and high-performing alternative that addresses the growing regulatory and market demand for safer, more sustainable antimicrobial solutions while reducing the risk of microbial resistance.

[Check out the results](#)

MAKING IMPACT THROUGH COLLABORATION

RELIANCE FINAL CONFERENCE

Against the backdrop of springtime Prague - a city where centuries-old architecture meets cutting-edge innovation - five Horizon Europe projects came together during the *Surfaces, Interfaces and Coatings Technologies International Conference 2026 (SICT2026)* to tackle a pressing question for Europe's advanced materials sector: **how can promising antimicrobial nanocoating technologies successfully move from scientific breakthroughs to real-world applications.**



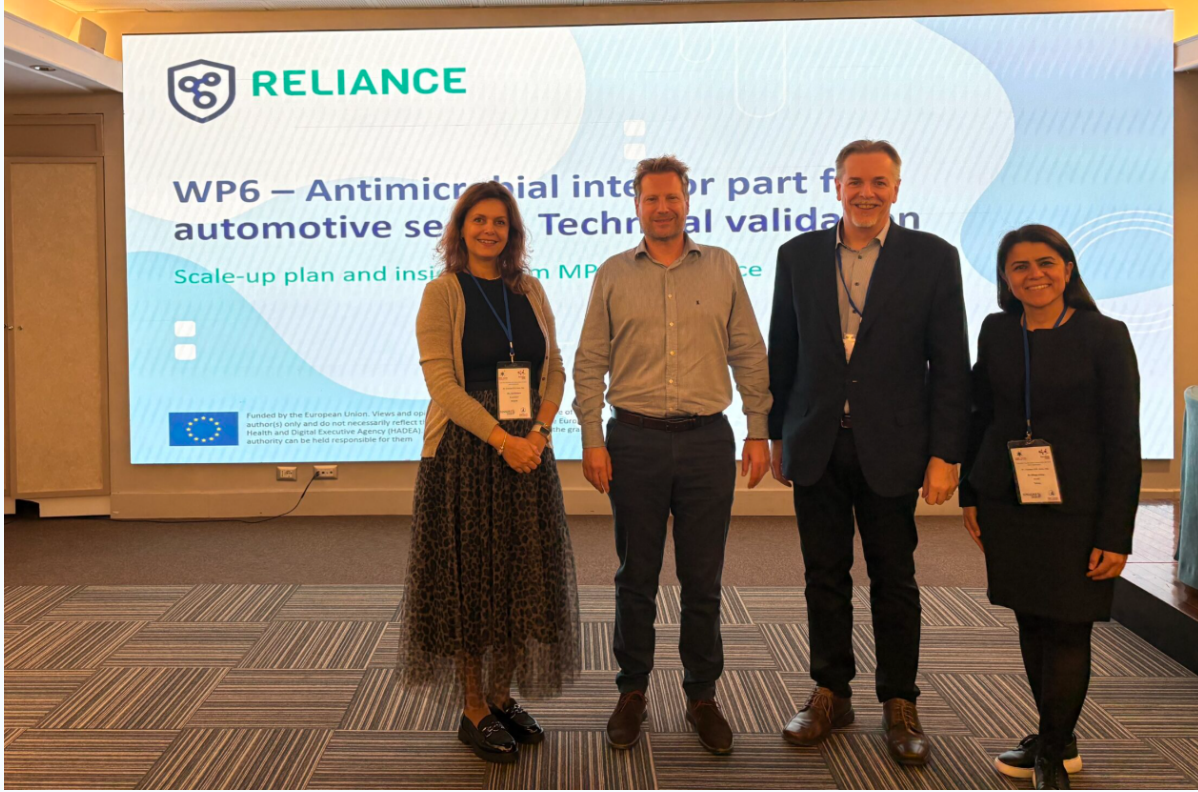
Hosted at the Grandior Hotel Prague on 7 May 2026, the hybrid workshop **“Antimicrobial Nanocoatings: Aligning Innovation, Regulatory Compliance and Market Uptake”** brought together 45 participants from across Europe, including 26 attendees in person and 19 joining online.

The event united the EU-funded projects RELIANCE, NOVA, NANOBLOC, SUPREME and MIRIA in a shared effort to discuss not only scientific advances, but also the practical realities of scaling up, validating and deploying antimicrobial materials in industry and society.

[Read the full story here](#)

[Download the press release](#)

NEXT-GEN NANOCOATINGS Workshop Showcasing Breakthroughs in Antimicrobial Innovation



Three EU-funded projects RELIANCE, NOVA and NANOBLOC, successfully hosted the *Next-Gen Nanocoatings: Accelerating Antimicrobial Innovation with Modeling & AI* workshop during the Smart Materials and Surfaces (SMS) Conference in Rome. The event was held on 30 October 2025 and brought together leading researchers, industry experts and materials science stakeholders to explore the future of antimicrobial surface technologies.

Held at the Courtyard by Marriott Rome Central Park, the workshop featured a dynamic agenda focused on scientific excellence, industrial relevance and real-world impact. RELIANCE opened the day with emphasizing the urgent need for innovative nanocoating solutions that can address global health and sustainability challenges.

[Continue reading](#)

DISSEMINATION WITH THE SCIENTIFIC COMMUNITY

**RELIANCE Featured Across Major International
Conferences in 2026**

In the final year of the project, RELIANCE partners from the University of Rome Tor Vergata (UNITOV) were active across several high-level scientific conferences, presenting the project's latest advances in smart, sustainable sensing technologies for antimicrobial performance detection, reinforcing the project's visibility within the global analytical chemistry and biosensing communities, biodefence and electrochemistry, demonstrating the project's multidisciplinary contribution to safer surfaces and antimicrobial innovation.

At the [7th International CBRNe Conference 2026 in France](#), RELIANCE showcased its progress on Cu-MSN modified antimicrobial nanocoatings to an audience of experts working in biodefence, pathogen surveillance and contamination control. The project's smart-response formulations attracted considerable interest for their potential use in environments requiring rapid, reliable antimicrobial action. The discussions highlighted how RELIANCE's materials could support safer operational settings, particularly in high-risk or high-contact areas.

RELIANCE results were also presented at the [Workshop on Electrochemistry of Electrochemically-active Materials 2026](#), where Prof. Fabiana Arduini, UNITOV presented the advantages of using carbon black to develop electrochemical sensitive sensor, while also highlighting its first time demonstration within RELIANCE project in using paper-based electrochemical device modified with carbon black for essential oil detection in antimicrobial coatings. The workshop provided an important platform to connect RELIANCE's antimicrobial materials with complementary detection technologies that support safer surface management.



The project was also represented at the [International Symposium on Advanced Analytical Methods in Research & Industry 2026 in Tunisia](#), where Prof. Arduini highlighted analytical approaches used to characterize Cu-MSN nanoparticles and bioactive compounds. These presentations reinforced RELIANCE's scientific foundation, demonstrating how robust analytical methods underpin the development of safe, effective antimicrobial materials. The symposium offered valuable opportunities to exchange knowledge with researchers working on advanced materials, nanostructures and sustainable chemistry.

Together, these three conferences illustrated the breadth of RELIANCE's scientific impact — from biodefence applications to electrochemical

sensing and advanced analytical characterization — and showcased how the project's innovations contribute to Europe's transition toward safer, more sustainable antimicrobial solutions.

In addition to the above conferences, UNITOV actively promoted RELIANCE and their results at several other scientific forums. At the [Smart, Sustainable and Ready for the Field workshop](#) in Split, partners showcased portable sensing technologies capable of detecting essential oils and disinfectant compounds, underscoring RELIANCE's contribution to field-ready analytical tools. During the [Third-Year Meeting of the MUR Excellence Program 2023–27](#), UNITOV presented RELIANCE's integration of green chemistry principles into sensor development, highlighting the project's alignment with national research priorities in sustainable innovation.

RELIANCE
Functionalized materials with essential oils for eco-friendly antimicrobial nanocoatings

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Introduction

Antimicrobial resistance poses a serious threat to global health, leading to increased morbidity, mortality, and economic burden [1, 2]. Addressing this urgent issue requires innovative strategies to prevent bacterial spread, especially through contaminated surfaces. The overriding goal of Horizon Europe RELIANCE project is the development of advanced antimicrobial technologies by creating innovative coatings based on mesoporous silica nanoparticles (MSNs) functionalized with metallic copper and essential oil. These coatings are specifically designed to boost antimicrobial effectiveness beyond existing solutions [3]. Our research aims to: i) evaluate the antibacterial properties of selected essential oils—eugenol, carvacrol, thymol, and menthol—against clinically relevant bacterial strains (*Escherichia coli*, *Bacillus clausii*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*); ii) identify the most effective essential oil for nanoparticle functionalization; iii) synthesize and characterize copper functionalized silica nanoparticles with the selected essential oil to develop broad-spectrum antimicrobial coatings; and iv) assess the antimicrobial activity of these nanomaterials against both Gram-positive and Gram-negative bacteria.

Experimental methods

Minimum Inhibitory Concentration (MIC)
Minimum Bactericidal Concentration (MBC)
Time Killing Assay

Results

We evaluated the efficacy of eugenol, carvacrol, thymol, and menthol against five bacterial strains (*Escherichia coli*, *Bacillus clausii*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*) by performing a series of assays, namely MIC, MBC, and Time Killing Assay. Among the four essential oils, thymol and carvacrol exhibit the strongest antibacterial activity, showing the lowest MIC/MBC values and achieving a 99.9% bacterial kill rate (3 log reduction) in just 30 minutes at significantly lower concentrations compared to eugenol and menthol. Eugenol requires the highest concentrations to achieve the same bactericidal effect. On the other hand, due to limited antimicrobial activity exhibited by menthol, and its markedly lower performance compared to the other essential oils tested—combined with issues related to its resuspension—no further experiments were carried out on this compound.

Essential Oil	<i>E. coli</i>		<i>B. clausii</i>		<i>S. aureus</i>		<i>P. aeruginosa</i>		<i>K. pneumoniae</i>	
	MIC (mg/ml)	MBC (mg/ml)	MIC (mg/ml)	MBC (mg/ml)	MIC (mg/ml)	MBC (mg/ml)	MIC (mg/ml)	MBC (mg/ml)	MIC (mg/ml)	MBC (mg/ml)
Carvacrol	0.4 mg/ml	0.8 mg/ml	0.4 mg/ml	0.8 mg/ml	0.2 mg/ml	0.4 mg/ml	0.2 mg/ml	0.4 mg/ml	0.1 mg/ml	0.2 mg/ml
Eugenol	0.4 mg/ml	1.5 mg/ml	1.5 mg/ml	3.7 mg/ml	0.8 mg/ml	3.1 mg/ml	3.1 mg/ml	3.1 mg/ml	1.1 mg/ml	25.0 mg/ml
Thymol	1 to 10 ⁻⁵	8.2x10 ⁻⁵	3 to 10 ⁻⁵	2.5x10 ⁻⁵	5.0x10 ⁻⁵	5.0x10 ⁻⁵	5.1x10 ⁻⁵	5.2x10 ⁻⁵	5.1 mg/ml	5.1 mg/ml
Menthol	10.0 mg/ml	n.d.	n.d.	n.d.	10.0 mg/ml	10.0 mg/ml	n.d.	n.d.	n.d.	n.d.

Notes: MIC and MBC values of carvacrol, eugenol, thymol, and menthol against *E. coli*, *B. clausii*, *S. aureus*, *P. aeruginosa*, and *K. pneumoniae*. n.d.: not determined. * menthol dissolved in H₂O; † menthol dissolved in ethanol; ‡ menthol dissolved in DMSO; n.d.: not determined.

Conclusions

To highlight the potential of copper-functionalized nanoparticles combined with carvacrol as effective antimicrobial coatings, offering promising applications in transmission and raising the antimicrobial resistance on frequently touched surfaces, surpassing current surface-coating technologies.

References

1. Antibiotic Resistance of Bacteria in Hospitals, Lancet, 2015, 386, 175-180.
2. Global Action Plan on Antimicrobial Resistance, Geneva, Switzerland: World Health Organization, 2015.
3. Multifunctional mesoporous silica nanoparticles for biomedical applications, Smart Materials Today, 2023, 24, 435.

Acknowledgements

Project funded by Horizon Europe (grant agreement 101019715) and the Italian Ministry of University and Research (MUR) (grant agreement 2022-2023).

Finally, RELIANCE's paper-based electrochemical sensors were again in the spotlight at [EMEC25](#), where UNITOV team showcased their relevance for rapid, eco-friendly analysis of antimicrobial compounds and environmental contaminants.

These additional engagements further amplified RELIANCE's scientific presence, demonstrating the project's commitment to sustainable materials, smart sensing technologies and antimicrobial innovation across diverse research communities.

More information about these dissemination events can be found in the [News](#) section on RELIANCE website while ***all poster presentations showcasing specific results*** are downloadable from [here](#).

SCIENTIFIC PUBLICATIONS

New Scientific Publication on Copper-Modified Mesoporous Silica Nanoparticles



nanomaterials

an Open Access Journal by MDPI



Copper-Modified Mesoporous Silica Nanoparticles for Antimicrobial Applications

Amaia M. Goitandia; Maialen Argaz; Miren Blanco; Giorgia Grilli; Elisa Recchia; Alessandra Amoroso; Nathalie Totaro; Andrea Ciammaruconi; Riccardo De Santis; Leire Ruiz Rubio; Fabiana Arduini; Florigio Lista

Nanomaterials **2025**, Volume 15, Issue 24, 1884

RELIANCE partner and project coordinator **Tekniker** has published an important open-access scientific contribution in *Nanomaterials*, presenting a comprehensive study on **copper-modified mesoporous silica nanoparticles (Cu-MSNs)** designed for broad-spectrum antimicrobial applications.

The paper, authored jointly with UNITOV and ISBD, demonstrates how carefully engineered copper functionalisation can deliver potent antibacterial and antiviral performance while supporting antibiotic-free strategies to combat microbial infections. The obtained results featured in the study underscore the strong potential of Cu-MSNs as sustainable antimicrobial agents aligned with RELIANCE's mission to advance safer surfaces and mitigate antimicrobial resistance.

[Go to the full publication in *Nanomaterials*.](#)

Publication on Polymer Structure and Hydration Dynamics

A second scientific contribution relevant to RELIANCE's modelling and materials research was published in *Polymers*, presenting a combined experimental and molecular dynamics investigation into the structural behaviour of short poly(N,N-dimethylaminoethyl methacrylate) (PDMAEMA) chains in dilute aqueous solutions.

The study, authored by researchers from the **University of Patras** and collaborating institutions, explores how pH, temperature, molecular weight and salt concentration influence the polymer's conformation, hydration state and aggregation tendencies. The findings reveal that while PDMAEMA maintains a relatively stable global shape across varying temperatures and salt levels, its aggregation behaviour is strongly affected under slightly more concentrated conditions, and a clear transition from collapsed to stretched conformations occurs when shifting from basic to acidic pH. These insights deepen the

understanding of polymer–water interactions and chain dynamics, supporting the broader scientific foundation behind RELIANCE’s work on advanced materials and molecular modelling.

[The full article is available in *Polymers*.](#)

FROM OUR BLOG

A Safety-by-Design Approach for Evaluating Human Hazards of Bio-Based Self-Disinfecting Nanocoatings

By INERIS

An article exploring how a **Safety-by-Design** methodology is being applied to ensure that the project’s bio-based self-disinfecting nanocoatings are not only effective but also safe for people and the environment. By integrating hazard evaluation at the earliest stages of material development, partners can anticipate potential risks, refine formulations, and support responsible innovation in line with EU Safe-and-Sustainable-by-Design principles. The article highlights how combining advanced material design with robust hazard assessment strengthens public trust and contributes to safer antimicrobial solutions for real-world use.

[Read the full blog post](#)

Making the Best Use of Friendly Chemistry with Atmospheric Plasma Coating

By Molecular Plasma Group

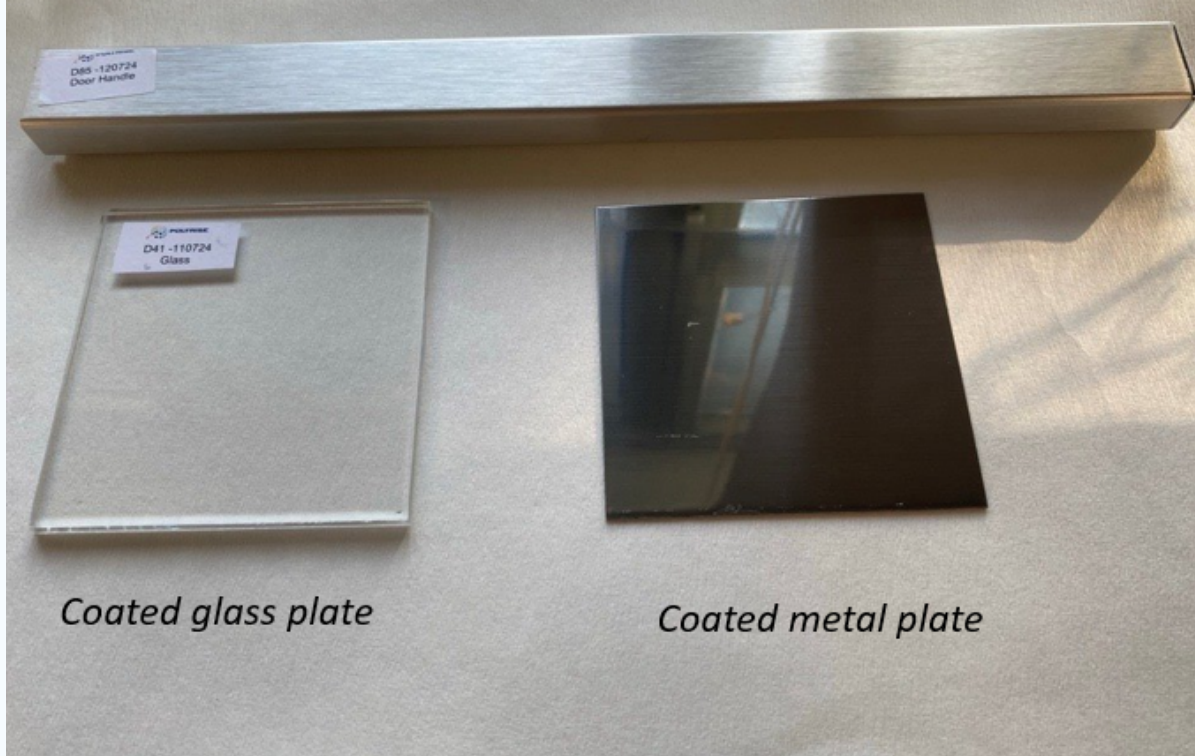


Another recent blog on our website highlights the advantages of **atmospheric plasma deposition**, a sustainable coating method used in RELIANCE to apply antimicrobial active ingredients with minimal chemical consumption and extremely low energy use. Developed by Molecular Plasma Group, this “molecular plasma coating” process replaces aggressive chemical treatments with a gentle, electricity-driven plasma that can permanently bond sensitive biomolecules, such as antimicrobial peptides, onto surfaces at room temperature. This continuous, solvent-free, low-energy process enables industrial-scale application of RELIANCE’s bio-based actives while significantly reducing environmental impact.

[Read the blog post](#)

From Lab to Product: Advancing Sustainable Functional Coatings for Consumers and Industry

By POLYRISE



POLYRISE are taking readers behind the scenes of RELIANCE's efforts to translate laboratory breakthroughs into **market-ready functional coatings**. This blog article describes how partners are refining formulations, validating performance on real substrates, and preparing prototypes for consumer and industrial applications. The piece emphasizes the importance of collaboration across scientific, industrial, and regulatory teams to ensure that RELIANCE's antimicrobial and water-repellent coatings meet durability, safety, and sustainability requirements. As the project enters its final phase, this work is central to ensuring that RELIANCE technologies can be successfully adopted by manufacturers and integrated into everyday products.

[Read the full blog post](#)

**NETWORKING FOR
AMPLIFYING KNOWLEDGE**

In RELIANCE, we believe that building strong connections with relevant projects, platforms, networks, and initiatives is essential to maximizing European projects' impact and enhancing the value of their outcomes. This collaborative approach supports our shared mission of fostering more resilient societies and promoting sustainable living.

Effective synergies emerge from actively establishing and maintaining relationships with ongoing projects, sharing similar goals, and developing resources through a collaborative lens.

Advancing Safe and Sustainable Innovation: Insights from the INTEGRANO project Webinar on the new EU SSbD Framework



SSbD Framework and Policy at the EU Level

An overview of the **revised SSbD framework** and the gathering of **feedback** from **industry stakeholders**

Online webinar

10th February 2026 10:00-11:00 am CET

In the beginning of the year, the INTEGRANO project hosted an online webinar dedicated to the **Safe and Sustainable by Design (SSbD) Framework and its policy context at the EU level**, bringing together **119 participants** from across research, industry, and policy. The event provided timely insights into how SSbD is evolving from a policy concept into a **practical driver of innovation**, directly resonating with the objectives of the RELIANCE project and its work on advanced nanocoating technologies.

The presentations highlighted collaboration across EU-funded initiatives as essential for ensuring that **safety, sustainability and performance** are embedded from the very start in innovation processes, an approach that we embraced in RELIANCE too.

The event also showcased the **SSbD Hub**, a knowledge and data exchange platform developed by INTEGRANO to support companies and innovators in the **practical implementation of SSbD principles**. Launched in 2024, the platform offers open access to videos, presentations, guidance documents and capacity-building activities, including online and in-person workshops.

[Read all about it](#)



RELIANCE project ends in **August 2026** but its research results are leaving a legacy that will continue to make **real-world impact**, aligning **antimicrobial nanocoating innovation** with regulation, standards and market needs.

Thank you for being part of RELIANCE Journey!
Get in touch if interested in our results uptake or future collaboration.

RELIANCE project is social. Visit our [website](#) or stay in touch by following us on

[LinkedIn](#), [X](#) and [Zenodo](#)



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