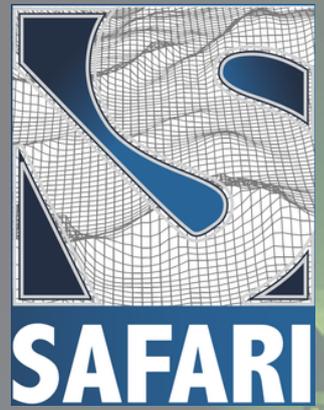


# SAFE AND SUSTAINABLE BY DESIGN GRAPHENE/MXENES HYBRIDS



e-NEWSLETTER  
*Magazine*

5<sup>th</sup> ISSUE  
March 2026

## Content

1. Conductive Inks (Printing the Energy Transition)
2. Biosensor Fabrication (The Healthcare Revolution)
3. EMI Shielding (Securing the Digital Frontier)

**Special Edition -  
From Research to  
Real-World  
Possibilities**



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# Welcome to the SAFARI e-Newsletter's 5th issue!

## THE FUTURE OF 2D MATERIALS: GRAPHENE AND MXENES MARKET OUTLOOK

The European Union is in a crucial position as we move through 2026, aiming for digital security, a green transition, and enhanced citizen well-being. We at SAFARI have the opportunity to be in the forefront of this goal by exploiting the remarkable qualities of MXenes and Graphene.

This edition marks a significant shift: from laying the scientific groundwork to demonstrating tangible impact. We are moving beyond the potential, showcasing how our Safe and Sustainable by Design (SSbD) hybrid materials are not just groundbreaking in the lab, but are actively addressing some of the most pressing global challenges.



Figure 1: Bridging the gap between 2D material potential and real-world solutions.

In the following pages, we invite you to explore the "Power of Two"—the unique synergy of Graphene and MXenes—through three key application areas. From transforming our energy systems and securing our digital communications to revolutionizing healthcare and environmental protection, SAFARI is engineering real-world solutions. Discover how our Conductive Inks, Biosensor Fabrication, and EMI Shielding technologies are laying the foundation for a smarter, more resilient, and sustainable Europe.

The SAFARI's Newsletters:

Throughout the 42-month project, we'll be releasing multiple e-newsletters, each showcasing the milestones achieved by our partners in development of 2D materials using safe and sustainable practices.

INNOVATION  
STRATEGY

# 1. Conductive Inks (Printing the Energy Transition)

Conductive inks are fundamentally changing how we manufacture electronics. By moving away from traditional, energy-intensive metal etching and toward additive "print-on-demand" processes, these materials are making electronic production faster, cheaper, and more sustainable.

The synergy between Graphene and MXenes in hybrid ink formulations offers a unique combination of high electrical conductivity, mechanical flexibility, and excellent environmental stability.

## WHAT THIS TECHNOLOGY ENABLES:

### Flexible & Wearable Electronics:

These inks can be deposited onto non-traditional, lightweight substrates—such as plastics, textiles, and paper—without sacrificing electrical performance. This allows for the creation of stretchable circuits, smart clothing, and bendable interfaces that conform to human movement or curved surfaces.



Figure 2: Power of Two: Graphene & MXenes in action.

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# 1. Conductive Inks (Printing the Energy Transition)

## Next-Generation Photovoltaics:

In solar technology, hybrid inks enable the printing of high-efficiency, lightweight electrodes directly onto flexible surfaces. This removes the need for rigid, heavy glass substrates, opening the door for integrated solar power in building materials and portable energy solutions.

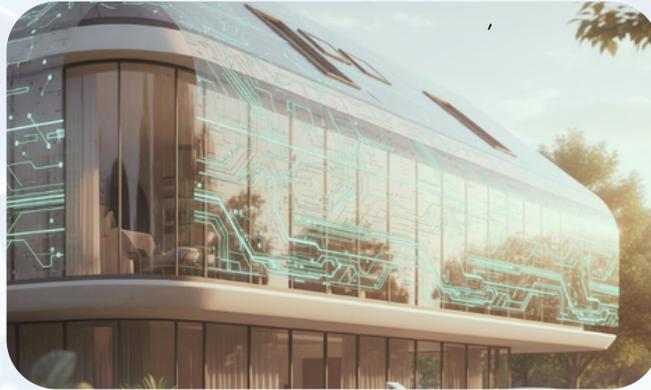


Figure 3: Next-generation solar integration for modern architecture.

## Thermal Management in EVs:

Because these hybrids can be tuned for both conductivity and heat dissipation, they are highly effective for printed thermal management layers in battery packs. This improves the regulation of battery temperatures during high-speed charging cycles, contributing to faster, safer, and more durable energy storage systems for electric mobility.

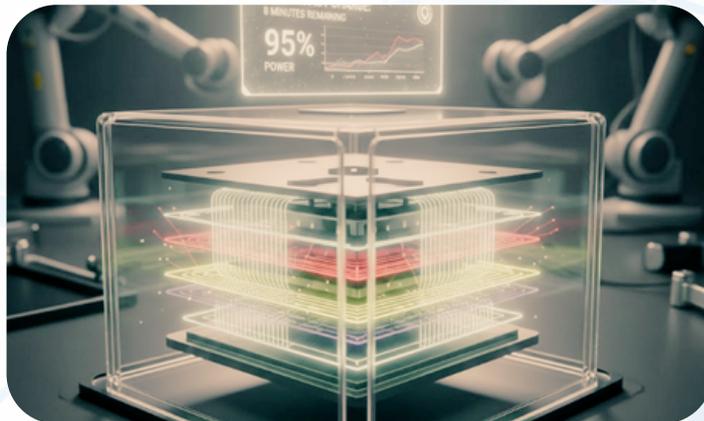


Figure 4: Scalable thermal solutions for EV batteries.

By replacing traditional, resource-heavy manufacturing with scalable printing techniques, Graphene-MXene inks are establishing a new standard for efficient, high-performance electronics.

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REDEFINING  
LIMITS

## 2. Biosensor Fabrication (The Healthcare Revolution)

2D hybrid layers—combining graphene and MXenes—offer an interface with a high surface-area-to-volume ratio and tunable chemistry. This architecture can enable highly sensitive interfaces capable of detecting specific biological markers at very low concentrations.

### WHAT THIS TECHNOLOGY ENABLES:

Healthcare:

Electrochemical Biosensors:

- **How it works:** Uses the high electrical conductivity of graphene/MXene hybrids to detect electron transfer during biological reactions.
- **Potential:** Ideal for highly sensitive, miniaturized "lab-on-a-chip" devices that can detect low-concentration analytes (e.g., glucose or viral proteins) in real-time.

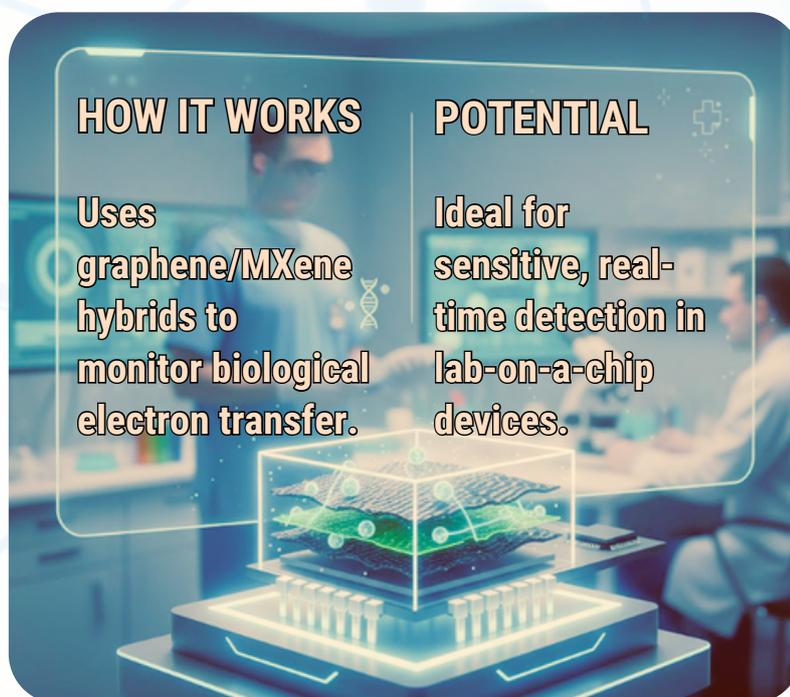


Figure 5: High-sensitivity electrochemical biosensors.

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## 2. Biosensor Fabrication (The Healthcare Revolution)

### Field-Effect Transistor (FET) Biosensors:

- **How it works:** The 2D material acts as the transistor channel; when a target molecule binds to the surface, it changes the electrical conductance of the material.
- **Potential:** Highly scalable and ultra-sensitive; these are the primary candidates for skin-conformal, wearable health patches that track sweat biomarkers continuously.

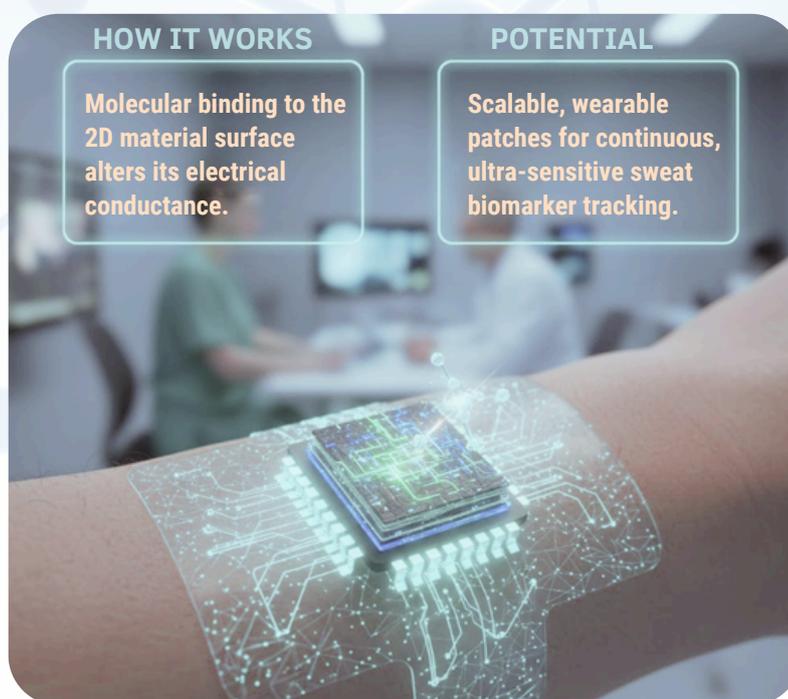


Figure 6: Wearable FET-based patches for continuous health monitoring

### Optical/Plasmonic Biosensors:

- **How it works:** Integrates 2D materials with light-based detection (like Surface Plasmon Resonance) to amplify signals when molecules bind to the surface.
- **Potential:** Offers exceptional specificity for detecting complex biological interactions, making them perfect for high-accuracy diagnostics in point-of-care settings.

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### 3. EMI Shielding (Securing the Connection)

As electronic devices become more compact and communication frequencies reach higher ranges, electromagnetic interference (EMI) has emerged as a significant challenge, causing signal degradation and hardware malfunctions. Graphene-MXene hybrid materials offer a superior alternative to traditional metal-based shielding. Their unique 2D lamellar structure, combined with high electrical conductivity and tunable surface chemistry, allows for the development of lightweight, flexible shielding solutions that manage electromagnetic energy through both absorption and reflection, effectively preventing secondary radiation emissions.

#### WHAT THIS TECHNOLOGY ENABLES:

##### Telecommunications (6G & Satellite):

- Advanced protective layers could shield high-frequency electronic components in 6G infrastructure and satellite systems, where traditional materials often struggle to maintain signal integrity.
- By mitigating electromagnetic interference and signal "cross-talk," these materials may help ensure the reliability and speed of next-generation communication networks.

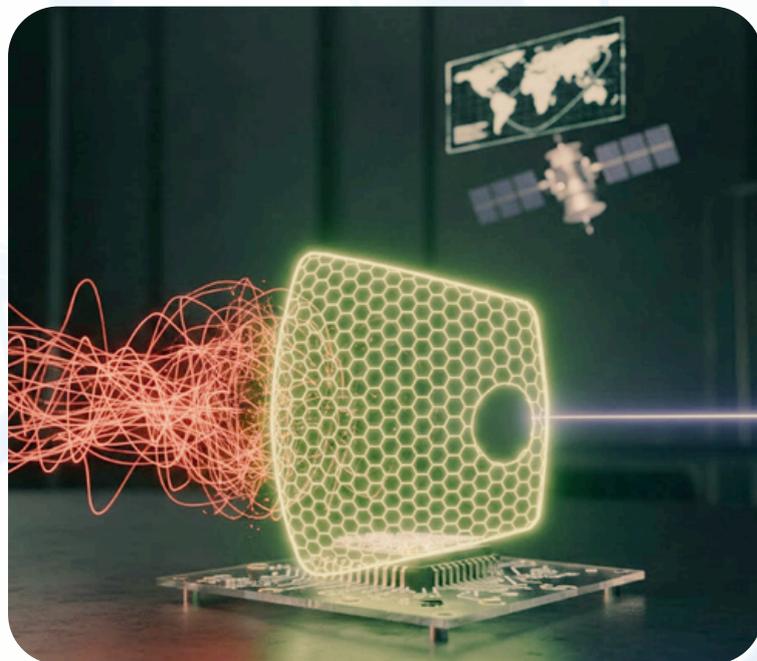


Figure 7: Advanced EMI shielding for next-gen 6G and satellite infrastructure

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### 3. EMI Shielding (Securing the Connection)

#### Aerospace & Defense:

- Conductive fabrics and coatings could be integrated into aircraft and drone hulls to protect sensitive flight electronics from interference.
- Due to their low density, these materials offer potential benefits for weight reduction in aerospace applications—a critical factor, as every kilogram saved in aviation directly contributes to long-term fuel efficiency and reduced CO emissions.

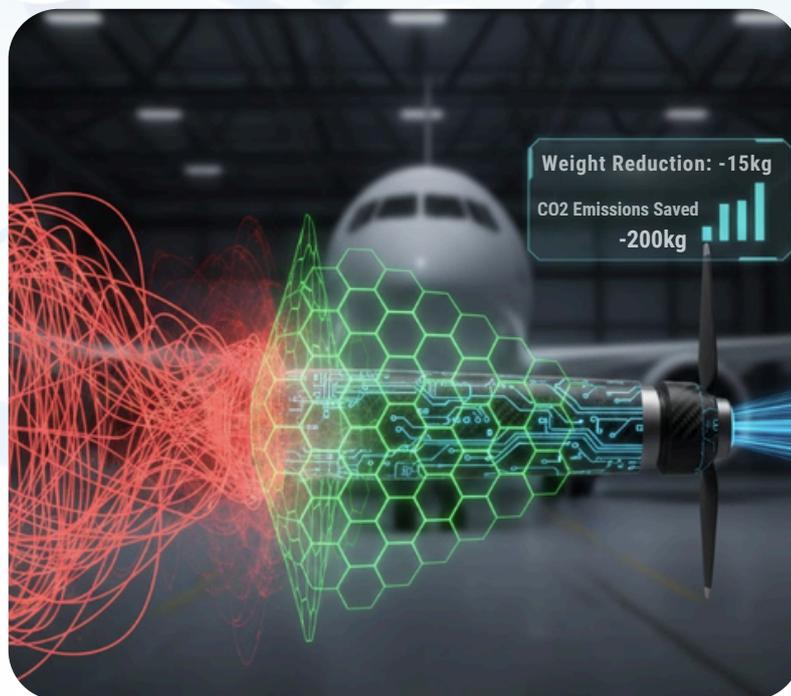


Figure 8: Lightweight 2D material solutions for modern aviation

#### Structural EMI Shielding

- **Integrated Protection:** Graphene-MXene hybrids are integrated directly into composite structural components, creating built-in EMI shielding.
- **Weight & Space Efficiency:** This structural approach eliminates the need for heavy, add-on shielding layers, reducing overall weight to improve fuel efficiency and lower CO2 emissions

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## 3. EMI Shielding (Securing the Connection)

### SHIELDING SOLUTIONS

#### Absorption-Dominant Coatings:

- **How it works:** Instead of solely reflecting electromagnetic waves, these coatings are engineered to dissipate wave energy as heat within the material's conductive network.
- **Potential:** Essential for modern, densely packed electronic hardware where reflection-based shielding could cause internal signal noise.

#### Flexible Conductive Polymer Composites:

- **How it works:** Embedding graphene and MXene nanomaterials into lightweight polymer matrices creates durable, flexible shielding that can be molded into various forms.
- **Potential:** Ideal for the automotive and aerospace sectors, where shielding needs to be integrated directly into structural components to save space and weight.

#### Lightweight Aerogels & Foams:

- **How it works:** These materials utilize a highly porous, low-density 3D architecture to maximize the surface area available to interact with and attenuate electromagnetic waves.
- **Potential:** Offers one of the highest shielding-effectiveness-to-weight ratios, making them perfect for high-frequency satellite components and critical defense electronics.

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SECURING THE  
CONNECTION

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