AddMorePower

ADVANCED MODELLING AND CHARACTERIZATION FOR POWER SEMICONDUCTOR MATERIALS AND TECHNOLOGIES

FOSTERING A MORE RESILIENT POWER ELECTRONIC INDUSTRY

NEWSLETTER

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Budget

€ 5.9 Million
100% EU-funded

Consortium

10 Partners
6 countries

Duration

48 Months
01/2023 - 12/2026

Project status after two years

In this issue, we highlight our recent participation at major international events and share the latest technical progress from our project. In the past months our team finalized the scientific data policy, installed NOMAD Oasis instances at partner institutions, and successfully started publishing open data to the public repository. We made major progress in understanding defects and dislocation behavior through advanced electron and X-ray microscopy, including a breakthrough in understanding pore formation in copper as well as a breakthrough in terms of the world's first nano-second time-resolved operando imaging of the switching and piezoelectric swelling of a GaN transistor. We also successfully completed a second series of GaN „layer-under-test" samples and distributed them to project partners for specialized analyses. At several conferences on semiconductors and material science as well as fairs like the World of Quantum and Advanced Materials Show, our partners have been showcasing cutting-edge research and innovations to an international audience, improving our contribution to materials science.

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Conferences and events

Let's review the recent events we've participated in:

01 Review meeting

End of June, the AddMorePower consortium gathered in Leuven, Belgium for a key milestone in the project: the second review meeting with the European Commission. The meeting was attended by our Project Officer, representing the Commission, and an independent external reviewer.

Over the course of the day, project partners presented the progress of all work packages. The atmosphere was constructive and engaging, with a few clarifying questions raised - mainly to better understand specific approaches and methodologies applied in our project.

At the end of the day, the feedback was very positive. Both the Project Officer and the reviewer were impressed by the scientific quality of the work and the progress made so far. They also expressed strong interest in the upcoming publications and results that AddMorePower will deliver in the final project period.

02 Conferences and workshops

5th International EMMC Workshop

The AddMorePower project was proudly represented at the 5th International EMMC Workshop, hosted by the European Materials Modelling Council (EMMC) at the Technical University of Vienna. The EMMC plays a central role in shaping the future of materials modelling in Europe. It brings together stakeholders from research, industry, and policy to promote standardization, interoperability, and data integration. The main goal of this year's workshop is to discuss how accelerated innovation and sustainability can be supported by a Knowledge Ecosystem based on materials modelling and data-driven collaboration.

Two of our project partners contributed to the workshop program:

- André Clausner from Fraunhofer IKTS introduced the AddMorePower project, sharing insights into the overall setup and data structure.
- Peter Imrich from Infineon/KAI presented on advanced characterization techniques used within the project.

As a research and innovation project we are proud to contribute to the EMMC's goal to develop new and improved materials paving the way for a sustainable European industry and society.

5th International EMMC Workshop

In early June 2025, Fatin EL AJJOURI from our project partner Université de Lorraine gave a talk at the 20th International Conference on the Strength of Materials (ICSMA20) in Kyoto, Japan. ICSMA provides a global platform for the latest research in materials strength — with this year's focus on metals, alloys, composites, biomedical materials, and emerging materials. Fatin's presentation, titled "Effect of free surfaces on dislocation elastic fields: application to threading dislocations in GaN", reflected important work being done within the AddMorePower project.

15th International Conference on Nitride Semiconductors in Malmö

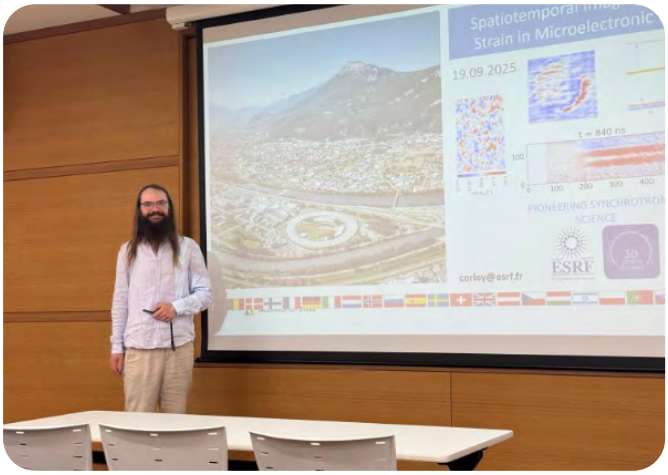
At the 15th International Conference on Nitride Semiconductors in Malmö (ICNS-15), Cedric Corley-Wiciak from project partner ESRF presented our latest work on "Operando Strain Microscopy in GaN/Si High Electron Mobility Transistors with Nanosecond Time Resolution" — a key contribution to understanding material behavior under realistic conditions.

Advanced Materials Show and World of Quantum

In the same month Agnieszka Anna Corley-Wiciak from project partner ESRF represented the AddMorePower project at the World of Quantum fair in Munich — a leading event for quantum technologies. With over 160 companies, startups, and research institutions showcasing the latest advancements in quantum computing, communication, and sensor technology, it was an exciting space to connect materials science with future tech.
At the Advanced Materials Show in Birmingham in July 2025, Agnieszka represented AddMorePower at the ESRF booth and shared insights in our recent research activities in a panel discussion on "Advances in Materials Characterisation".

International Conference on Solid State Devices and Materials

In September, our project partner ESRF represented AddMorePower at the SSDM Conference 2025 in Japan. On 16th September, Cedric Corley-Wiciak held a presentation entitled "Multi-Scale Strain Landscape of Al_{1-x} Ga_xN/GaN/Si Heterostructures Probed by X-ray Diffraction Microscopy". Just a few days later, on 19th September, he chaired the 318th SPring-8 Seminar titled "Spatiotemporal Imaging of Lattice Strain in Microelectronic Devices at Beamline ID01", highlighting ESRF's expertise in advanced X-ray characterization.



03 Technical progress

WP2 - Data Management and Workflows

During this period, the focus was on finalizing the AddMorePower Scientific Data Policy (AMP-SDP), which now provides clear guidelines on the collection, storage, sharing, and ownership of research data. This policy builds on the project's Data Management Plan and ensures that all AMP data is handled transparently and responsibly, supporting reproducibility and collaboration. The team successfully installed five NOMAD Oasis instances at partner institutions, while the central AMP internal repository was deployed on AWS, hosted by Infineon Technologies Austria. Although additional cybersecurity and compatibility work caused a minor delay, these challenges did not affect open data publication, as a dedicated FAIR data pipeline enabled the first successful upload to the public NOMAD repository.

To simplify data documentation and upload, four new NOMAD data parsers—covering DAMASK, Synchrotron SXDM data, TXRM, and EBSD data—were implemented and shared on the AddMorePower GitHub. The consortium also played an active role in the CEN/CENELEC workshop on materials characterization terminology, contributing to the revision of the CWA 17815 standard. Building on this work, new CHADAs and MODAs were created, providing structured templates for data and workflow documentation that are now publicly available via the EMMC community space on Zenodo. The team also reached two major milestones: the deliverable of the AMP Material Science Repository (D2.3) and the documentation of the first complete AMP workflow, "Towards Virtual ECCI" marking significant progress toward fully integrated, FAIR, and interoperable data practices across AddMorePower.

WP3 - Advanced X-Ray-Based Characterization Methods

WP3 continued to push the boundaries of structural characterization in the use cases 1 (GaN/Si heterostructure) and 2 (Cu intermetallics), using both laboratory and synchrotron-based X-ray methods. With the acceptance of a Long-Term Proposal at ESRF, the project secured an impressive 1200 hours of beamtime over the next 2.5 years. This access is already yielding high-impact results: diffraction and imaging data have been collected from GaN/Si heterostructures and Cu polyheaters, shedding light on degradation mechanisms and strain evolution under operational conditions. New setups and analytical tools are enabling experiments that have never been performed before—most notably, the operando observation of piezoelectric strain fields in GaN HEMTs during transistor switching, a world-first at microscopic resolution.

At the same time, IKTS completed 3D reconstructions of thermally cycled Cu polyheaters, revealing crack networks with micrometer precision, while Excillum's micro-CT imaging uncovered detailed damage patterns in wire-bonded Cu structures. Continuous improvements to the in-situ experimental setups and data analysis pipelines—now leveraging parallel processing for massive datasets—are ensuring that upcoming beamtimes at ESRF's ID03 and ID11 will deliver even more insight. A manuscript summarizing the GaN use case results is in preparation, marking another step toward dissemination of AddMorePower's cutting-edge characterization achievements.

WP4 - Advanced Electron-Based Methods

The WP4 team made major progress in understanding defects and dislocation behavior through advanced electron microscopy. KAI and LEM3 successfully completed ECCI characterization of threading dislocations in GaN, systematically investigating the influence of foil thickness and rocking curve parameters. Complementary HR-EBSD measurements are now being compared to quantify global dislocation densities and local stress fields. In copper metallization studies, the team has nearly completed its analysis of dislocation microstructure evolution.

A breakthrough was also achieved in understanding pore formation: new in-situ experiments demonstrated that pores in copper grow only under stress through grain boundary-assisted diffusion at elevated temperatures. Meanwhile, the setup of the HC IUMI TEM at CEMES continues to advance, enabling time-resolved cathodoluminescence (TRCL) measurements on GaN foils with unprecedented spatial and temporal resolution thanks to newly installed UV-sensitive detectors. Together, these efforts are delivering a comprehensive picture of how defects and microstructures evolve across materials and time scales.

WP5 - Microstructure-dependent Multiscale and Multiphysics Modelling

WP5 has made significant progress in linking microstructural features to material behavior through advanced modelling. Simulations of copper polyheaters have begun to reveal how local tensile stress hot spots develop under cyclic loading, with grain boundary sliding and visco-plastic effects providing a physical explanation for void nucleation and growth. Models using COMSOL and FEM approaches are being refined to capture these effects across multiple cycles, while DAMASK has been further developed to enable combined thermo-chemo-mechanical simulations, laying the groundwork for future integrated analyses.

On the GaN side, Field Dislocation Mechanics and FFT-based simulations are providing insight into threading dislocation behavior in layers on Si substrates, predicting strain and stress signatures that will be compared with EBSD, HR-EBSD, and ECCI data. These efforts, combined with close collaboration with experimental partners, are establishing validated hypotheses for degradation mechanisms in copper and GaN, and advancing the development of predictive full-field and mean-field models for lifetime and reliability assessment.

WP6 - Demonstration and Validation

Demonstration and validation advanced steadily during this reporting period. The team successfully completed the second series of GaN "layer-under-test" (LUT) samples, now available in multiple configurations, including GaN:C, AlGaN, and GaN:Mg layers. These samples have undergone extensive TEM and SIMS characterization, and thin foils have been distributed to project partners for specialized analyses such as holography, EELS, TRCL, EPIC, XBIC, and ECCI.

Meanwhile, a new batch of Cu polyheaters is progressing through the process line, ensuring the project's two main material platforms—GaN and Cu—remain closely aligned for parallel structural and performance validation. These activities lay the groundwork for the integration and demonstration phases to follow, bringing the consortium's multidisciplinary advances together in functional, validated prototype structures.

04 Outlook

As AddMorePower moves into its next phase, the focus shifts from exploration to consolidation. The scientific and technical topics developed over the past periods continue to advance steadily, with new results emerging across all work packages. This marks an exciting time for the consortium — a phase of harvesting the fruits of its collective efforts.

In the coming months, emphasis will be placed on dissemination: publishing scientific papers, sharing datasets through open repositories, and presenting findings at international conferences. These activities will ensure that the project's outcomes reach the wider materials science and semiconductor communities. At the same time, exploitation efforts will be intensified to secure the long-term impact and sustainability of the project's achievements, ensuring that AddMorePower's innovations continue to benefit both research and industry well beyond its lifetime.

AddMorePower Consortium

The AddMorePower consortium consists of ten highly qualified partners from five countries (Germany, Austria, France, Czech Republic and Belgium). Among them are four highly innovative research centres, a large internationally recognized industry partner for material and component production, an industrial competence center, two large research-based universities and two highly skilled multicultural SMEs.
The AddMorePower consortium represents a diverse pool of skills and competencies to address and solve the industry's many challenges.

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Video material created

You can find all videos and interviews in the AddMorePower **Video Showcase** !

GitHub

Make sure to check out our **GitHub Repositories** as well!

Upcoming Events

Visit our website for more info:
addmorepower.eu/events/

All past and upcoming events can be found on the AddMorePower official webpage.