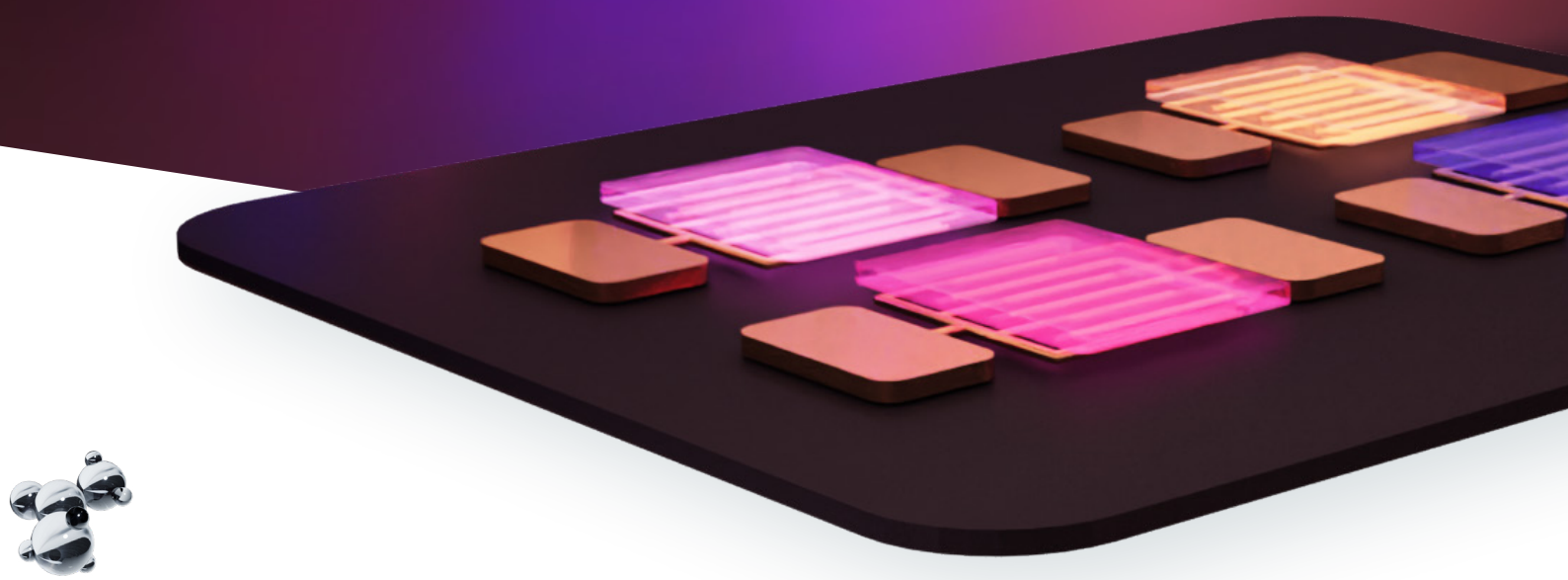
Multi-pixel gas sensor platform

FOR A WIDE RANGE OF APPLIANCE AND CONSUMER MARKETS



Message from the Project Management Team

The intention of this newsletter is to provide news on the project progress and to discuss ongoing topics relevant to AMUSENS. This newsletter is intended for internal and external project partners, stakeholders and all other interested bodies. For more detailed information about the project, we invite you to visit our project website, which is constantly updated with the latest project related news.

amusens-horizon-europe-project

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A new AMUSENS project partner– ICCS

AMUSENS-Hop-On project was granted by the European Commission in April 2025. This means that a new partner, ICCS (The Institute of Computer and Communication Systems) joined the AMUSENS consortium from Greece and will complement project activities by analysing the produced data from the breath analysis sensor developed in AMUSENS and by developing an AI model to support optimized sensor calibration, through calibration transfer, considering batch-to-batch variability. This new use case of personal stress estimation will be realized by experiments involving healthy volunteers, incorporating ICCS driving simulation laboratory. ICCS will complement the already planned work on AI interpretation by adding model-agnostic interpretability analysis of the AI-based models for calibration transfer and AMUSENS use-case models. ICCS will also support the dissemination, communication and exploitation activities, by organizing additional schools/workshops and end-user engagement events, giving special focus on audiences from R&I widening countries as well as other Horizon Europe Destinations in which ICCS is involved.

ICCS is the oldest and one of the largest academic research institutes in Greece. It is the research branch of the School of Electrical and Computer Engineering of the National Technical University of Athens (NTUA), and it was founded in 1989 as an independent, non-profit body. Since then, ICCS has a valuable impact on the country's scientific output by producing outstanding research results in areas such as hardware and software technology, computer network technology, digital communications technologies, automation technologies, energy and power production technologies, biomedical and biomechanics technologies, information systems and management decision technologies, photonic technologies for communications, etc. The Institute maintains well-organized facilities based in Athens and has a reputation as a top-level research institution worldwide. Scientific research at ICCS is organized within many cross-cutting thematic research units (groups and labs) that bring together researchers, academic staff, PhD students and faculty members from the National Technical University of Athens (NTUA). With more than 800 highly qualified researchers and having participated in more than 4,000 national and European R&D projects, ICCS offers a world-class research environment and a dynamic hub that nurtures learning, continuous skill cultivation, international collaboration, and innovation, uniquely adapted to the ever-changing landscape of the digital age.

The I-SENSE Group is one of the most dynamic research units of ICCS. Founded in 2002, the I-SENSE Research Group is committed to the highest standards of academic excellence and today employs more than 150 researchers who carry out basic and interdisciplinary cutting-edge research across 10 thematic divisions: Connected Cooperative Automated Mobility (CCAM), Earth Observation and Environmental Monitoring (EOEM), Multimodal Logistics & Maritime Operations (ML), Industry 5.0 & Smart Manufacturing (ISM), Circular Economy & Tracing (CET), Smart Mobility Applied Systems (SMAS), Intelligent Networks & Services (INS), Crisis Management and Secure Societies (CMSS), Health Technologies (HT) and Extended Reality (XR). Aiming to generate real value for society and the economy, I-SENSE Group actively supports research exploitation activities and participates in two successful spin-offs."

Technical Update

The main objective of AMUSENS is to develop a low-power gas sensor platform with adaptable selectivity to different gas environments by combining metal oxide (MO) multi-pixel sensing approach and trained artificial intelligence (AI), and to demonstrate the adaptability to three use case applications chosen in the fields of personal environmental monitoring and health care (metabolic states), as well as stress levels estimation. Here, we present an update on the work carried out so far to meet each objective of AMUSENS:

Objective 01

AMUSENS will start with the definition of targeted gases for the targeted applications and relevant MO structures for specific gas sensing, with the aim to build up a database for the choice of material combinations in the multi-pixel sensor.

Assessment of the status – partially completed: The selection of target gases and sensing materials has been finalised in WP4 and formally validated through the achievement of milestone 2. From the two targeted end-user applications in monitoring personal exposure and breath analysis, 14 gases have been selected either from their occurrence in the literature or due to their potential importance. The selection of the sensing materials was performed through a bibliographic review using a list of selection criteria on their gas sensing properties, processability, estimated stability. Moreover, a hazard assessment (Step 1 of the SSbD framework) was performed on a preliminary list of materials, thus establishing a list of materials potentially interesting for further development and passing the hazard assessment criteria, including 6 metal oxide nanostructures to be deposited by inkjet printing and 6 coatings to be deposited by DALP®. The sensing properties of the various combinations of materials (MO nanostructure + coating) for the targeted gases are under investigation in WP6.

Objective 02

AMUSENS will develop new inks based on MO nanoparticles for local inkjet printing as well as DALP® of thin films onto micro-hotplate array for fast screening of materials and process parameters, and final device processing.

Assessment of the status – partially completed: All metal oxide nanostructures determined in objective 1 have been successfully synthetized by liquid-phase synthesis, and the most challenging ones (anisotropic morphology, largest size) have been used to optimize the ink formulation, with a recipe that was then adapted to other materials. First local inkjet printing has been demonstrated for 4 materials and will be extended to all synthetized materials by the end of WP5. For the DALP® technique, the deposition of 5 coatings has been demonstrated with the current resolution of 350 µm. The conditions for the ink formulation, inkjet printing and DALP® deposition of the selected materials have been assessed through the achievement of milestone 4 and can now be transferred to WP7 for the local deposition on the multi-pixel platform.

Objective 03

AMUSENS will develop specific AI for (1) fast material screening, (2) data fusion during the gas sensor training and measurement phases and (3) calibration transfer between sensor batches in order to reduce calibration time/cost/gas consumption and ensure the potential scalability of sensors mass production for targeted applications.

Assessment of the status – partially completed: (1) A first selection of AI algorithms has been benchmarked on data already available from commercial gas sensors as well as with the first data from WP6. The selection of the algorithm for gas sensing materials (milestone 5) has been delayed due to the current lack of data from WP6 but will be recovered within the next period. Other parts of the objective are not addressed yet as they are related to future WP 8.

Objective 04

AMUSENS will demonstrate a new multi-pixel gas sensor platform with a wider range of materials combination, low weight, low power consumption and high integration capabilities, combined with specifically design AI algorithm.

Assessment of the status: Not addressed yet (related to future WPs 7 and 8).

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Objective 05

AMUSENS will demonstrate the performance of its gas sensing platform on monitoring individual exposure to pollutants and critical gases.

Assessment of the status: Not addressed yet (related to future WPs 8 and 10).

Objective 06

AMUSENS will demonstrate the performance of its gas sensing platform on monitoring biomarkers in exhaled breath.

Assessment of the status: Not addressed yet (related to future WPs 8 and 10).

Objective 07

AMUSENS will investigate one additional use case related to exhaled breath analysis for stress-estimation, leveraging also information collected with wearable wristbands previously developed by ICCS for measuring stress related vitals. Environmental exposure sensors, developed in AMUSENS, will be utilized for simultaneous collection of information regarding the conditions during the stress-estimation experiment.

Assessment of the status: Not addressed yet (related to future WPs 8 and 10).

Objective 08

AMUSENS-Hop-On will apply model-agnostic methods for providing enhanced interpretation of the AI models' results towards improved understanding of MO sensors' outputs and their functioning principles. This knowledge will be shared with new talent pools, end-users and stakeholders from a broad range of application domains.

Assessment of the status: Not addressed yet (related to future WPs 15 and 16).

Past and upcoming events:

AMUSENS end user co-design Workshop in July 2025

AMUSENS will consider multiple aspects of individual and social behaviours, needs, experiences, expectations, ethical concepts and principles, and societal implications of the use of multi-pixel gas sensor platform through co-design workshops.

The first workshop was organised by AMUSENS partner SFC in Barcelona, Spain, July 15th.

AMUSENS at EUROSENSORS 2025 in September 2025

Eurosensors, a highly successful series of conferences, has become the leading European forum to cover the entire field of sensors, actuators, microsystems and nanosystems. This year the 37th European Conference on Solid-State Transducers Eurosensors 2025 will be held in Wrocław, Poland, Sept. 7th - 10th 2025.

AMUSENS will be present at this conference and will organise a workshop 'Low-cost multi-pixel gas sensor platform – end-user needs and standardization' on Monday, Sept. 8th – afternoon.

More details will follow soon on AMUSENS events website.

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