The Instrumentation for Nanoparticle and Nanomaterial Synthesis and Characterization Laboratory (INL), is a research & innovation facility of the Climate and Atmosphere Research Centre (CARE-C) of The Cyprus Institute (CyI), offering great possibilities for designing, building and testing novel solutions for probing key parameters of the atmospheric environment. INL's activities include:

- Developing and testing low-cost particulate mater sensors and instruments
- Designing and building high-end aerosol instrumentation
- Synthesizing nanomaterials for novel air quality gas sensors

Combining expertise from a wide range of disciplines (Physics, Chemistry, Material Sciences, and Engineering) and state-of-the-art facilities, INL has the capacity to provide innovative technological tools for tackling global challenges, such as aspects related to climate change and human health. The mission of INL is to develop new disruptive Environmental Sensing Technologies that will expand our abilities to monitor the atmospheric environment in unprecedented ways. INL operates in close collaboration with other key CyI infrastructures, including the Cyprus Atmospheric Observatory, the Unmanned Systems Research Laboratory, the Environmental Chemistry Laboratory and the High Performance Computing Facility, as well as with a number of academic and industrial partners, thereby maximizing knowledge transfer and its impacts on society.

The Climate & Atmosphere Research Center (CARE-C) is a 100-research-staff Centre-of-Excellence established in 2020 at The Cyprus Institute with €45 million of competitive funding from EU's H2020-Teaming and the Cyprus Government. Its mission is to establish a regional hub of knowledge to address air pollution and climate change in the Eastern Mediterranean and Middle East through research, innovation and education activities with a regional focus.

The Cyprus Institute (CyI) is a non-profit research and educational institution with a strong scientific and technological orientation. It is an issue-oriented institution, emphasizing international collaborations and cross-disciplinary research and post graduate education. CyI is being developed by establishing research centers to address important and challenging problems at both the regional and international levels, in partnership with leading, world-class institutions.

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THE CYPRUS INSTITUTE
RESEARCH·TECHNOLOGY·INNOVATION

EMME-CARE
EASTERN MEDITERRANEAN MIDDLE EAST – CLIMATE & ATMOSPHERE RESEARCH CENTRE

Instrumentation for Nanoparticle and Nanomaterial Synthesis and Characterization Laboratory

Novel Tools for Air Quality and Material Sciences Research

Major Partners

Max Planck Institute for Chemistry (Germany)

Delft University of Technology (The Netherlands)

University of Helsinki (Finland)

Lund University (Sweden)

National Observatory of Athens (NOA, Greece)

NSCR Demokritos (Greece)

ADITESS LTD (Cyprus)

EMBIO Diagnostics (Cyprus)

Fasmatech (Greece)

TSI (USA)

NAQTS (UK)

ITENE (Spain)

People

Prof. George Biskos (Head of INL)

Prof. Andreas Schmidt-Ott (Adjunct Professor)

Dr. Anne Maisser (Associate Research Scientist)

Dr. Spyros Bezantakos (Associate Research Scientist)

Dr. Somnath Bhowmick (Associate Research Scientist)

Dr. Klito Petalidou (Post-Doctoral Research Fellow)

Marinos Costi (Mechanical Engineer)

Neoclis Hadjigeorgiou (Electrical/Electronic Engineer)

Fabian Schmidt-Ott (PhD Candidate)

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Research Projects

EMME – CARE: Eastern Mediterranean and Middle East – Climate and Atmosphere Research Center

DIVINE: Development of an Innovative and Versatile Nanomaterial Synthesis Platform

OASIS: Development of Eco-friendly Nanocapsules-based Self-Healing Systems

ART-SARS: Air Particle SARS Detection

MAGNUM: Monitoring for Aerosol Particle Growth and Chemical Composition During New Particle Formation Events Using Miniaturized Lightweight Instrument

PRECEPT: Portable and Cost-effective Particulate Matter Monitoring System

AQ-SERVE: Air Quality Services for a Cleaner Air in Cyprus

ACCEPT: Assessment of Climate Change Effects on Pollution Transport in Cyprus

ASPASIA: Mass Spectrometer for the Advanced Investigation of the Atmospheric Aerosol

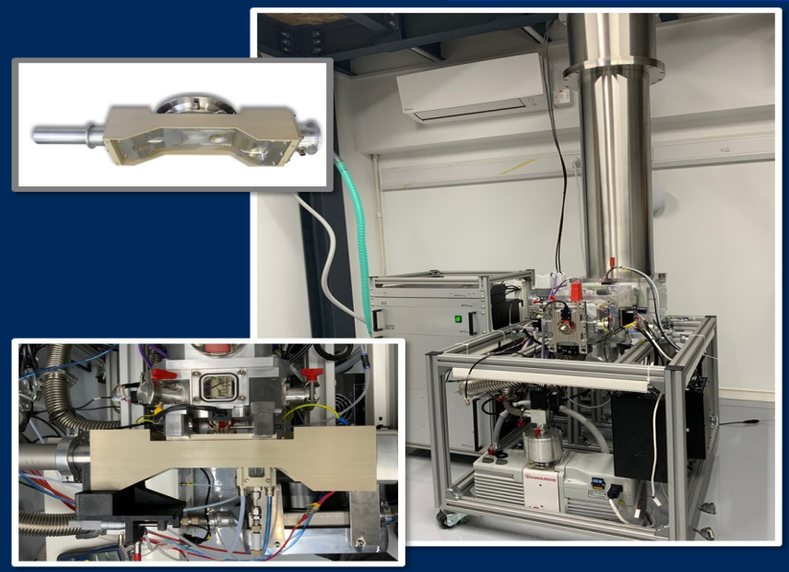
The INL Facility

The Instrumentation for Nanoparticle and Nanomaterial Synthesis and Characterization Laboratory (INL), focuses on aerosol particle synthesis and characterization. The lab is equipped with tools for:

- synthesizing aerosol particles having compositions and sizes over a wide range (from atomic clusters to micrometer-sized particles), and using them to produce function materials.
- probing the key properties of aerosols (ambient and/or engineered), including their size, number, mass, charge, shape, hygroscopicity and volatility.
- characterizing the performance of portable or miniature air quality sensors within a wide envelope of pressures and temperatures, emulating conditions similar to those prevailing when employed onboard Unmanned Aerial Platforms.

INL's multidisciplinary team, develops custom instrumentation for tackling modern scientific challenges, related to air quality, climate change and human health. The next generation of cost-effective, portable and miniature devices is of special interest, since they will significantly contribute in novel research approaches requiring a high spatiotemporal resolution in diverse environments.

Prototype Cost-Effective PM monitor



Differential Mobility Analyzer coupled with Atmospheric Pressure Interface Time of Flight Mass Spectrometer (DMA-API-ToF-MS)

Research & Innovation Activities at INL

INL develops new sensing technologies that fall in three main categories: 1. advanced aerosol instrumentation for probing physicochemical properties of atmospheric aerosol nanoparticles, 2. low-cost instruments and sensors for measuring the physical properties of aerosol particles, and 3. metal oxide semiconducting gas sensors that will be sensitive and selective enough for air quality monitoring. Details of each category are provided below.

Advanced Aerosol Instrumentation

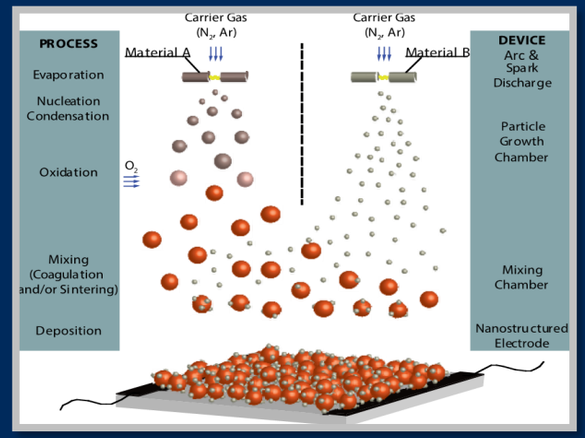
In collaboration with Research and Development companies that design and build high-end mass spectrometry systems, INL has recently embarked towards the development of a disruptive Aerosol Mass Spectrometer system that will be capable of providing detailed chemical and physical information of ambient aerosol particles with sizes ranging from the sub-nanometer range and up to a few hundreds of nanometers.

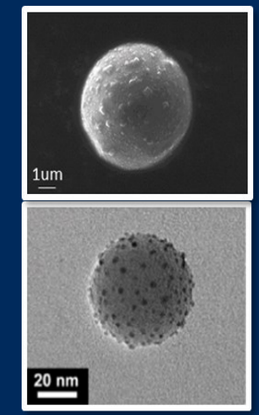
Low-cost Aerosol Instruments and Sensors

INL uses new manufacturing techniques to build low-cost instruments that can enable us to probe physical properties of the atmospheric aerosol particles (i.e., concentration, size, volatility and hygroscopicity) in ways and at accuracy levels that have not been possible before.

Metal Oxide Semiconducting Gas Sensors

INL has the ability to synthesize the building blocks, and subsequently the very sensing materials of the next generation of MOS gas sensors that will exhibit enhanced sensitivity and selectivity; two characteristics that currently prohibit their applications in air quality monitoring. Key in this research line is the flexibility and versatility of the synthesis methods to produce mixed nanoparticles comprised of more than one elements, including sophisticated structures of nanoparticles decorated with atomic clusters, that can attribute high selectivity to the resulting MOS gas sensors.





Nanoparticulate material synthesis using combination of spark and/or arc ablation (left), and examples of decorated nanoparticles produced by the method (right top and bottom).