



PhD in INGEGNERIA DEI MATERIALI / MATERIALS ENGINEERING - 39th cycle

**PNRR 118 PA Research Field: NEW TECHNOLOGIES FOR THE ASSESSMENT OF THE AIR
QUALITY: PARTICULATE MATTER ANALYSES AND RECOGNITION**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The project will be carried out at FunNMat Lab (Dipartimento di Chimica, Materiali e Ingegneria Chimica Giulio Natta, Polimi) in close collaboration with ARPA Lombardia, the regional agency for the environmental protection, and is aimed at the exploration of new enabling technologies, in order to ensure greater effectiveness of the public action in the monitoring and in the assessment of the quality of the air. Objective of the project is the recognition of pollution sources still difficult to be identified. By developing diagnostic tools, the project will contribute to enhance the administrative capacity in problem definition and in the identification of solutions.

Composition analysis of particulate matter (PM10 and PM2.5) in the air shows the presence of a high percentage of Organic Matter (till 50% of the whole mass). (Life PrepAIR-Report, 2021
https://www.lifeprepare.eu/?sdm_process_download=1&download_id=14507)

Different molecules constitute this component, of primary and secondary origin, from different sources and with very different health impact. To be able to address properly the measures to decrease organic matter in particulate and to give priorities to the most dangerous substances it should be important to have instruments and methods able to identify and quantify the different species inside PM10 and PM2.5, collected on filters on which a proper volume



	of air passes through. The methods adopted to investigate the composition of organic matter until now, are based on different techniques: • Thermal-Optical Analysis allows to measure the amount of the total particulate carbon (OCEC-Dual Optical Lab Instrument (Sunset Lab)), distinguishes organic carbon (OC) from elemental carbon (EC) through the monitoring of laser light, heating, and measuring evolved carbon; • the Aerosol Mass Spectrometer measure the real-time chemical speciation and mass loading of non-refractory (NR) aerosol particles (including organic matter) using aerodynamic lens together with thermal vaporization and electron-impact mass spectrometry; • the analysis of absorption, transmission and reflection of the light (Aethalometer, MAAP, ...) allow to characterize the optical properties measuring concentrations of Black Carbon. The use of other techniques, for instance those based on Molecular Spectroscopy could improve the knowledge in a significative way, allowing of an improvement also in the statistical approaches used to address the different sources of pollution.
Methods and techniques that will be developed and used to carry out the research	The main objective of the project is the exploration of alternative or complementary techniques for the analysis of the particulate matter collected on filters in air quality stations. A preliminary critical analysis of new methodologies today available and on advantages and limitation of the techniques presently adopted, will allow focusing on the requirements and on the gaps which could be filled by the exploitation of non-standard methods and new procedures for the analysis of PM₁₀ and PM_{2.5}. The potential of the use of infrared, UV-vis-NIR absorption spectroscopy, Raman and Surface Enhanced Raman Spectroscopy (SERS) in the recognition of organic matter and of its degradation



	recognition of organic matter and of its degradation products will be investigated, focusing on the effectiveness of micro-sampling and, possibly, considering <i>in-situ</i> analyses. The FuNMat Lab of Politecnico di Milano has a consolidated experience in molecular spectroscopy and in its applications to the study of organic and carbon based nanostructured materials, and the laboratory is equipped with state-of-the art experimental facilities for molecular and material spectroscopy. This guarantees the suitable scientific background and the instrumentation for testing reference materials and samples collected by ARPA during monitoring of the sites of interest. A frequent exchange of samples and scientific discussions with the researchers of ARPA, will provide the focus on the relevant issues in the framework of the mission of the public administration in the air quality assessment. A joint effort is also requested for a comparative evaluation of the results obtained with new approaches and by means of the analyses already implemented in the ARPA laboratories: this will be effectively done during the period spent by Ph. D. candidate at the ARPA laboratories. Finally, the project should contribute to the set-up of new protocols and to the implementation of statistical analysis concerning the detection and/or the quantification of specific analytes.
Educational objectives	The Ph.D. candidate will be able to conduct scientific researches in collaboration with the teams described above. This will provide the chance to learn the use of different experimental techniques in a multidisciplinary environment. Courses offered by the PhD Program in Materials Engineering will provide additional educational and cultural opportunities.
Job opportunities	Possible opportunities can be found in the Environmental Protection Agencies of the Italian Network for Environmental Protection. The experience acquired by the Ph.D. candidate in the use of optical techniques is also interesting for the industries dealing with the development and characterization of materials.



Composition of the research group	1 Full Professors 1 Associated Professors 3 Assistant Professors 1 PhD Students
Name of the research directors	Prof. Chiara Castiglioni / Dott. Cristina Colombi

Contacts	
<i>Prof. Chiara Castiglioni (Polimi)</i> chiara.castiglioni@polimi.it https://www.cmic.polimi.it/ricerca/elenco-gruppi-di-ricerca/funmat/ <i>Dott. Cristina Colombi (ARPA)</i> c.colombi@arpalombardia.it	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	ARPA Lombardia Via Rosellini, 17 20124 MILANO www.arpalombardia.it
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	da definire
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Individual budget for research (5.700 euro): 1st year: 1.900 euro; 2nd year: 1.900 euro; 3rd year: 1.900 euro Teaching assistantship (availability of funding in recognition of supporting teaching activities by the PhD student): there are various forms of financial for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities within the limits allowed by the regulation.