SUSTAINABLE MATERIALS, PROCESSES AND SYSTEMS FOR ENERGY TRANSITION

Micro-/nano-fabrication for better metrology for new challenges posed by energy transition

Funded By	I.N.RI.M. - ISTITUTO NAZIONALE DI RICERCA METROLOGICA [P.iva/CF:09261710017]
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Context of the research activity	This research proposal aims to explore innovative micro-electromechanical sensors (MEMS) for the energy sector, in particular with regards to energy gases and smart electricity grids, in order to promote the adoption of renewable sources and to reduce carbon-dioxide emissions. A significant requirement is to develop such research activity according to the best available metrological standards.
	Scholarship funded by INRIM. Main seat to carry out the research: Istituto Nazionale di Ricerca Metrologica (INRiM), Torino Supervisor: Pietro Asinari, p.asinari@inrim.it The European Union aims to produce over 32 % of its energy needs from renewable sources by 2030 to reduce carbon-dioxide emissions. The introduction of the Energy Union strategy, supported by directives and regulations that address all aspects of the energy supply chain, and measures to reduce energy consumption at point of use, has made Europe a world leader in this field. This strategy focuses efforts on sustainable and secure energy supplies, methods to reduce greenhouse gas emissions and increasing the competitiveness of European industries. Maintaining Europe's leading position requires the continuous development of new technologies alongside the ongoing use of conventional energy generation. The European National Metrology Institutes, through their European Association EURAMET, have contributed to advances in measurements that support the introduction of new energy sources as well the efficient operation of conventional power plants (https://www.euramet.org/metrology-for-societys-challenges/metrology-for-energy/). In particular, this proposal aims to push forward the edge of metrology for new challenges posed by energy transition and circular economy by using micro-/nano-fabrication, in particular with regards to energy gases and smart

Objectives	electricity grids. Research on micro-/nano-fabrication and characterization is carried out at INRiM from both fundamental and technological perspectives. In particular, INRiM has a long-lasting tradition in quantum metrology, because new measurement technologies and standard realisation for near future metrology are indeed based on quantum effects. Basic research on magnetic, electrical, optical and thermodynamic properties of matter is supplemented by the development of techniques for the realisation of quantum standards of the measurement units, as well as for innovative materials and nanostructured devices typical of emerging technologies, such as photonics, spintronics and nanoelectronics. In this proposal, the PhD student will have the opportunity to collaborate with the INRIM groups dealing with quantum electrical metrology, quantum optics, nanostructures & devices and magnetic materials for energy. Moreover, INRIM provides measurement traceability and supports the applications of metrology and measurement science in industry and society, which are ideal for the PhD student education. The key idea is to explore innovative micro-electromechanical sensors (MEMS) for the energy sector. This idea is widely explored within the European Metrology Networks (EMNs) which INRiM is involved in, in particular the EMN for Energy Gases and the EMN on Smart Electricity Grid. Objectives: • Explore the landscape of different energy applications, in particular with regards to energy gases and smart electricity grids, in order to find the most promising opportunities for MEMS; • Define reference sensors, available in the market, for industrial benchmarking; • Define and improve metrological chains using MEMS and/or novel MEMS for the target application; • Provide a proof-of-concept of the advantages of the developed sensor.

Skills and competencies for the development of the activity	• Good background about energy systems • Passion for measurements • Background about solid state physics is highly welcomed