



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 37th cycle

Research Area n. 1 - Advanced Materials and Smart Structures

**THEMATIC Research Field: FUNCTIONAL MATERIALS FOR 3D PRINTING OF
MICROSYSTEMS**

Monthly net income of PhDscholarship (max 36 months)

€ 1325.0

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**

Functional materials are attracting considerable interest due to their wide range of applications. These span the whole field of magnetic screening, magnetic data storage, chokes, sensors, actuators, MEMS and devices based on magnetoelectric coupling in multiferroic materials. Demand from the electronic industry for thick and thin film functional materials has dramatically increased, and novel design are continuously being developed based on the availability of 3D printing facilities. The main drawback in the production of films from powder is the need of a high-temperature sintering step, which must be carried out at several hundred degrees. Since the main cause of film failure is film spalling from their structural substrate during sintering due to mismatched thermal dilation coefficients, film bonding can hardly occur on any standardized substrate, irrespective of film composition. One potential solution is lower sintering temperatures that reduce the extent of the interfacial stresses caused by thermal mismatch, although there are physical constraints that cannot be overcome. It is known that nanosized ceramic particles can be sintered at lower temperatures compared to coarser ones, and allow the fabrication of thinner films. Synthesis of nanoparticles in polyols is a simple and convenient chemical route for producing highly stable suspensions of oxidic nanoparticles and magnetic oxides



	that can be 3D printed by inkjet and then sintered at lower temperatures.
Methods and techniques that will be developed and used to carry out the research	The methods to be used will involve nano powder production, optical and electron microscopy, EBSD, XRD, DSC, and mechanical characterization. For more details about infrastructures, see: https://www.mecc.polimi.it/us/research/departmental-laboratories/
Educational objectives	At the end of the PhD cycle the candidate will be able to define, design and carry out original research programs by working in a team or leading a research group in the field of smart materials. Opportunities will be offered for spending visiting periods hosted by project partners within scientific cooperation.
Job opportunities	All project activities are strongly connected to industrial needs and industrial partners are directly participating to project tasks. In this specific project, STMicroelectronics is directly involved in the research. Our last survey on MecPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared Master of Science holders in the same field.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 2 PhD Students
Name of the research directors	Prof. Nora Lecis, Dr.ssa Carmen Galassi

Contacts	
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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	564.01 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences):

2nd year: 1.534 euro

3rd year: 1.534 euro

Accommodation in Politecnico's Residences (<http://www.residenze.polimi.it>) is available for PhD candidates; special rates will be applied to selected out-of-town candidates (detailed info in the call for application).

Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months (approx. 550 euro/month- net amount).

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. There are various forms of financial aid 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 regulations.