



PhD in INGEGNERIA DEI MATERIALI / MATERIALS ENGINEERING - 38th cycle

PNRR_352 Research Field: TOOLS AND METHODOLOGY FOR 300MM POWER & DISCRETE
TECHNOLOGIES

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 study is supported by STMicroelectronics in the framework of the PNRR recovery plan, in line with 2 Missions:

Green revolution and ecological transition (M2C2 and M2C3) and "From research to enterprise" (M4C2), this last aiming at the introduction of PhD tracks for innovation in enterprises through the development of high-profile competencies in the *Key Enabling Technologies (KET)* identified by the EU commission.

Among *KET*, *microelectronics* and *advanced materials* play a significant role and are addressed by the present research project. The project in fact is aimed at creating knowledge and innovation in these areas, specifically by investigating topics for the development of *power devices supporting the switch to 300mm wafer technology*. Just to cite a few examples, in the frame of M2C2 already mentioned: better and sophisticated semiconductor-based solutions for power electronics are mandatory for efficient energy management (e.g. new sources of renewable energy, such as solar and wind, are increasingly integrated with conventional generation systems to meet growing demand while helping reduce CO₂ emissions) and for innovation in the automotive sector (by increasing engine performance and improving battery charging). Energy efficiency, renewable sources and mobility are among the pillars of the PNRR. The activity will involve characterization of novel structures and materials of interest for applications in the field of power devices,



	<p>including: presence and evolution of defects in silicon substrates, dopant distribution by epitaxial growth within deep trenches, interface between the final passivation layers (silicon nitride and polyimide) and their evolution as a function of heat treatments. One of the aims is the evaluation of metrological techniques / tools for characterization and process control. To support the characterization activity, the use of process emulators appropriately calibrated on the experimental results is envisaged.</p> <p>See also: https://www.st.com/en/solutions-reference-designs/power-energy-management-solutions.html https://www.st.com/content/st_com/en/about/innovation---technology/trench-gate-field-stop.html</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<ul style="list-style-type: none"> • Material and structure production by lithography techniques and epitaxial growth will be carried out at STMicroelectronics R&D labs; • material characterization will be carried out both at STMicroelectronics and at Politecnico di Milano (Nanolab, Department of Energy) by high resolution microscopy and spectroscopic techniques; • evaluation of techniques tools for characterization of defects and doping will be carried out also in the framework of international collaborations, during the period to be spent abroad. • Suitable theoretical and numerical models will be developed for the simulation of the growth process.
<p>Educational objectives</p>	<p>Education of people in the world of research and development for power management and efficient energy conversion. The next technological revolution associated with car electrification will need solid background and know-how in physics, technology and materials engineering. The candidate will be required to manage interdisciplinary issues, perform and interpret complex experiments and benchmark new equipment in an international context. Experts in materials engineering and</p>



	<p>their interactions along the process flow and during product lifetime will be more and more crucial to grant competitiveness and innovation content in the semiconductor world, which is finally recognized as a strategic sector for European industry, see: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-chips-act_it</p>
Job opportunities	<p>Private and public R. & D. Highly qualified positions in a wide range of industries related with production, development and use of materials. Huge investments are foreseen in Europe for the semiconductors world, due to the recent crisis faced in several applications field. Materials engineering experts will become crucial to enable the technological revolution.</p>
Composition of the research group	<p>3 Full Professors 4 Associated Professors 2 Assistant Professors 10 PhD Students</p>
Name of the research directors	<p>Prof. A. Li Bassi /Dr. P. Zuliani (ST)</p>

Contacts	
<p><i>Prof. Andrea Li Bassi (Politecnico di Milano, Department of Energy)</i> <i>andrea.libassi@polimi.ittel. +39 02 23996316</i> <i>www.nanolab.polimi.it</i></p>	
<p><i>Dr. Paola Zuliani (STMicroelectronics, Power & Discrete R&D)</i> <i>paola.zuliani@st.comtel. +39 039 6037924</i> <i>www.st.com</i></p>	

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)	STMicroelectronics - Via C. Olivetti 2, 20864 Agrate Brianza (MB) www.st.com
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	6

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

Confidentiality: since this is a thematic scholarship, the management of Confidential Information, Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary must sign a specific commitment.

Individual budget for research (during the 3 years): about 5.400 euro

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