



UNIVERSITÀ DI PISA  
**DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE**  
**Dottorato di Ricerca in Ingegneria dell'Informazione**

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Doctoral Course

**“Nanofabrication technologies and tools for 1D&2D-material based devices”**

Dr. Elisabetta Dimaggio

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**Short Abstract:**

Nanofabrication techniques have been the keystone for the scaling down of electronic devices in the semiconductor industry, but have also revolutionized other fields, being the means for the integration of nanodevices into various systems and contexts. Core components of nanodevices are low-dimensional semiconductive materials, which have allowed to boost the integration densities, but have also enabled the study and comprehension of various physical phenomena relying on their characteristic properties.

This course is meant to give an overview of the methods and tools required for the fabrication of devices based on one-dimensional (1D) and two-dimensional (2D) materials, which are the result of a body of knowledge in electronics, physics and material science. Particular focus will be given to hybrid processes that combine standard CMOS techniques, e.g. lithography, thin film deposition, chemical vapor deposition, wet and dry etchings, with alternative techniques for fast prototyping of electronic devices, such as ink-jet printing. Through these processes, 1D&2D materials can be integrated together with bulk materials allowing the complete definition of electronic devices, which can be further collected in large-area networks. Case studies related to emergent fields of application, such as energy harvesting[1] and flexible electronics [2] will be discussed and supported by practical examples of fabrication workflows.

**Course Contents in Brief:**

- Overview of standard fabrication methods for integrated devices
- Nanofabrication tools for micro and nanoscale devices
- Beyond the standards: alternative materials and technologies on flexible substrates
- Dive into practice: integration workflow from lithography to metal contacts and 2D-materials printing

**Total # of hours of lecture:** 16 hours

## References:

- [1] S. Elyamny, E. Dimaggio, et al., High power thermoelectric generator based on vertical silicon nanowires, Nano Letters 20 (7), 4748-4753
- [2] Brunetti, I, et al. Inkjet-printed low-dimensional materials-based complementary electronic circuits on paper. npj 2d materials and applications 5.1 (2021): 1-6.

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## CV of the Teacher

Assistant Professor of Electronics at the University of Pisa. She received the M. Sc. in Electronics Engineering and the Ph.D. in Information Engineering from the University of Pisa in 2015 and 2019, respectively. She has worked on the development of processes and technologies for the fabrication of electronic devices in the energy recovery and harvesting fields. Starting from consolidated techniques for the integration of electronic devices, she has developed high-efficiency thermoelectric modules based on forests of silicon nanowires and on networks of silicon nanomembranes. Recently, she has started a research activity on innovative concepts of fabrication based on two-dimensional materials, with the aim to define electronic devices and circuits on flexible substrates.

Author of 20 papers including research articles, conference proceedings and a book chapter (H-index 9 and more than 200 citations) mainly in electronic devices and nanotechnology.

**Final Exam:** team-project work development

## Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule:

Day1 – 14:00-18:00

Day2 – 14:00-18:00

Day3 – 14:00-18:00

Day4 – 14:00-18:00