



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

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Doctoral Course

**"Nano(bio)technology strategies for smart materials, devices, and systems"**

Prof. Matteo Palma

*Queen Mary University of London – U.K.*

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**Short Abstract:** The course will present an overview of nano(bio)technology strategies in the assembly, nanofabrication and characterisation of nanomaterials for the fabrication of functional nanoscale systems and devices. Bioinspired and biomimetic approaches will be discussed including an overview of the field of structural DNA nanotechnology. We will examine optoelectronic, (bio)sensing and biomedical applications of nanostructures of different dimensions (0D, 1D and 2D) and their assemblies, organized from solution to/on surfaces in device configurations via covalent and supramolecular strategies.

**Course Contents in brief:**

- I. Nanofabrication and nanoscale characterization
  - Nanofabrication: from photolithography to Electron-beam lithography and nanoimprint lithography
  - Imaging nanoscale materials surfaces: electron microscopy (SEM, TEM) and focus on scanning probe microscopy based techniques (STM, AFM, Conductive-AFM, Kelvin-Probe AFM, and Dip Pen Nanolithography)
  - Surface functionalization and introduction to the bottom up approach: linking molecular-level structures to macroscopic interfacial phenomena via Self-assembled monolayers (SAMs)
- II. Supramolecular strategies in materials science
  - Supramolecular chemistry: from self-assembled materials to molecular motors
  - Merging top-down lithography and bottom up strategies: research examples in materials science and biomimicking surfaces
- III. NanoBiotechnology
  - Bioinspired assembly and nanofabrication
  - Static and dynamic structural DNA nanotechnology: from materials science to biological investigations
- IV. Low dimensional materials, their nanohybrids and applications

- 0D, 1D and 2D nanomaterials: quantum dots, nanotubes and 2D nanosheets
- Nanohybrids of low dimensional materials including mixed dimensional heterostructures : from van der Waals to covalent and supramolecular approaches
- Optoelectronic, (bio)sensing and biomedical applications of low dimensional materials nanohybrids

**Total # of hours of lecture:** 20 of hours

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### **CV of the Lecturer**

Matteo Palma is Professor of Physical Chemistry and Nanomaterials in the Department of Chemistry at Queen Mary University of London (U.K.) . Since September 2013 he leads a research group ([the Palma group](#)) focusing on the controlled assembly of (low-dimensional) materials into functional nanohybrids/heterostructures, down to single-molecule resolution. Applications range from optoelectronics, to biosensing and biological investigations at the single-molecule level.

Trained as a physical chemist, Prof. Palma received a Masters degree from the University of Rome La Sapienza in 2004 and a PhD degree in 2007 from the University Louis Pasteur, France (now University of Strasbourg) working at the Institute of Supramolecular Science and Engineering (ISIS) investigating nanoscale structural and electronic properties of supramolecular assemblies for organic electronics, via scanning probe techniques. His doctoral work was awarded the “Young scientist award” by the European Materials Research Society.

He then worked as a postdoctoral scientist in the departments of Mechanical Engineering and Applied Physics at Columbia University (New York, U.S.A.) as part of the groups of Professor James Hone and Dr. Shalom Wind. At Columbia University he focused his research efforts on the use of surface chemistry and nanofabrication strategies to control (bio)molecular assembly at the nanometer scale, for: i) high throughput monitoring of bio-molecular interactions at the single-molecule level, and ii) controlled self-assembly of nanostructures in materials science.

Prof. Palma has supervised more than 15 PhD students (11 to completion) and 7 post-doctoral scientist, in addition to multiple Masters students, at Queen Mary University. He has published more than 90 peer-reviewed papers, 2 book chapters, and he has 2 issued patents ([Google Scholar](#)).

**Final Exam:** written test/MCQs

### **Room and Schedule**

Room: Ground Floor, Information Engineering Dpt, via G. Caruso 16, Pisa

Schedule: September 8<sup>th</sup> through 19<sup>th</sup>, 2025 - Mon-Fri 9:00-11:00 a.m.