Monolithically integrated Ge-on-Si heterostructure photodiodes

Silicon photonics addresses the study and the technological application of silicon as an optical medium for generation, transmission, modulation and detection of light. It has been envisioned that silicon photonics will solve the interconnect bottleneck of CMOS technology, by the on-chip integration of silicon based optical interconnects with standard electronic elements. This technology has already shown its tremendous potential for data communications in server farms and data storage centers, thanks to the huge investments placed by big players such as Intel and IBM. Nevertheless, on-chip applications require an higher level of integration and extremely low power consumptions. It has been envisioned that germanium, thanks to its photonic properties and its compatibility with CMOS technology, will pave a new the path through on-chip applications of silicon photonics. One of the most important building blocks of the silicon photonic technology is the photodetector, which is commonly made by a Ge-on-Si heterostructure photodiode. Moreover, the Ge-on-Si photodiode technology is also very interesting for imaging in the extended near-infrared spectral region.

The thesis activity will be focused on the optimization of the fabrication process of integrated Ge-on-Si heterostructure photodiodes, especially on design, optical lithography, plasma etching and metal contact deposition. The fabricated devices will be characterized by electrical and optical measurements. The thesis activity will be strongly focused on the technological and engineering aspects. Novel devices exploiting organic layers to boost the visible and UV responsivity will also be investigated. Skills acquired during the thesis work:

- Epitaxial growth of semiconductors by LEPECVD
- Micor-fabrication techniques (UV lithography, plasma etching, e-beam evaporation of metals)
- High resolution X-Ray diffraction measurements
- Atomic Force microscopy measurements
- Photocurrent spectroscopy
- Electrical measurements

List of selected publications: