Fabrication of InGaAs/InP based single photon avalanche detectors optimized for high efficiency at near infrared

Semester project

General Information

Laboratory: Advanced Quantum Architecture Laboratory (AQUA)
Partners: EPFL
Supervisor: Ekin Kizilkan, Utku Karaca, Prof. Edoardo Charbon
Location: CMi at EPFL (Fabrication), Microcity at Neuchatel (Measurement)
Starting date: ASAP
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Motivation

Single photon avalanche detectors (SPADs) are capable of generating a very fast output signal as a response to single photons. This allows them to be used for imaging at very low light levels and to construct 3D image of a scene by measuring the time of flight of a single photon with picosecond resolution. InGaAs/InP based single photon avalanche detectors are promising for the wavelengths which Silicon based ones are not efficient due to their large bandgap. However, they suffer from a sharp efficiency drop at the wavelengths below 900 nm due to substrate absorption. Therefore removing the substrate of the device would prevent this process and result in a significant improvement of the photon detection efficiency at the wavelengths below 900nm.

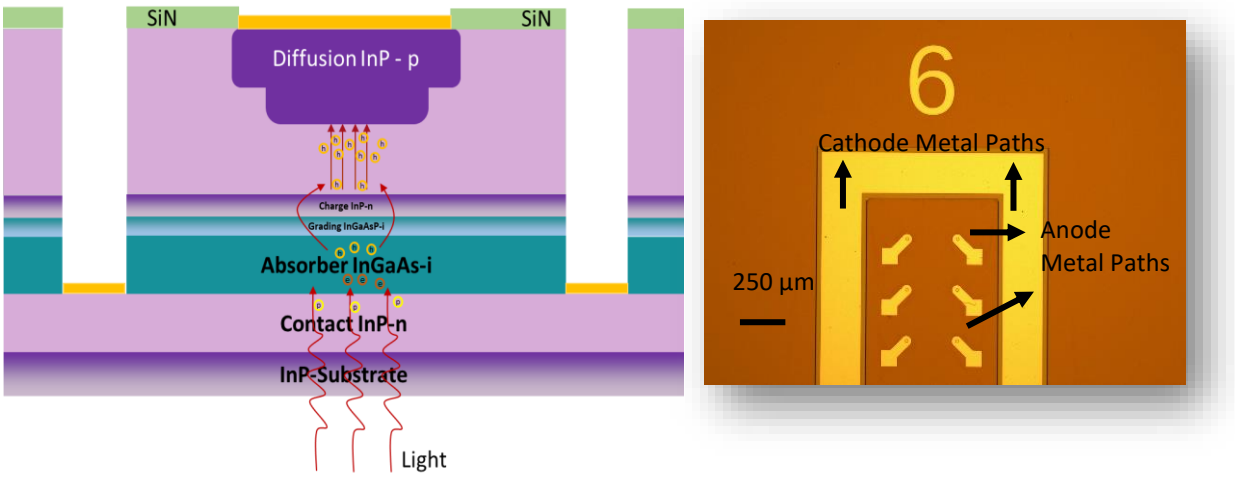

Fig 1: Layer cross section of an InGaAs/InP based SPAD (Left), top view of an InGaAs/InP based SPAD after fabrication (right)

Description

The goal of the project is to demonstrate efficiency improvement at the above-mentioned wavelengths by comparing the single photon efficiency spectrum of two InGaAs/InP SPADs with and without substrate. For this purpose student should fabricate these devices in CMi (Center of Micronanotechnology) by following various photolithography, etching, metallization and thinning processes. Following the fabrication, devices should be placed on a PCB and characterized for their photon detection efficiency. The student will have a chance to experience/perform all of the fabrication process of a single photon avalanche detector from scratch and set up an experiment to analyze the performance of the detector.

Tasks

- Literature search
- Fabrication of InGaAs/InP SPADs
- Measuring the single photon detection efficiency of InGaAs/InP SPADs