

Qualification work

Bachelor thesis | Research thesis | Master thesis

Fabrication and Characterization of SiGeSn-GeSn Heterodiodes

Motivation

The goal of Si photonics is to build a photonic integrated circuit (PIC) on a Si. One key element of such a PIC is a monolithically integrated laser on a Si substrate. Due to the indirect bandgap nature of Si and Ge, they are not suitable as amplifying material for a laser. A very promising approach is the use of the binary alloy semiconductor GeSn. Mixing Ge and α -Sn leads to a decrease of the Γ - and L -valley. Due to the negative direct bandgap of α -Sn the Γ -valley decreases faster than the L -valley, resulting in a direct bandgap semiconductor for Sn concentrations above 6%. Increasing the Sn content leads also to an increase of the average lattice constant and thus to a compressive strained GeSn layer when grown on Si or Ge. To overcome the compressive strain, which leads to a reduction in the directness of the material, the layer can be partially underetched, see figure 1. Additionally, adding Si to GeSn enables a decoupling of the bandgap and the lattice constant. This allows building heterostructures to confine charge carriers spatially in the optical-active region.

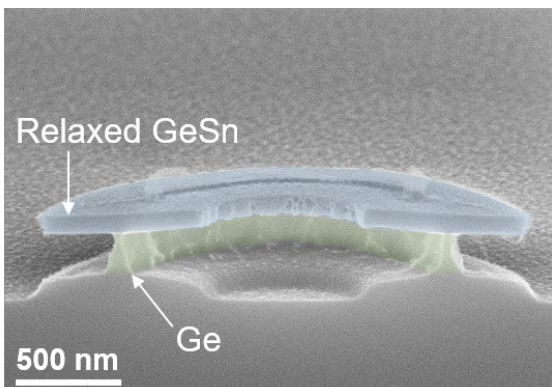


Figure 1: Cross-section of an underetched GeSn layer standing on a Ge pedestal.

Scope of the work

The scope of this work is to fabricate and characterize underetched SiGeSn/GeSn Heterodiodes. The fabrication takes place in our institute cleanroom. The main part of this work is to monitor and document the processes for the fabrication of underetched microring- and Fabry-Perot-resonators. After the fabrication, an intense electrical and electro-optical characterization should be done. The key goal of this work is electrical-pulsed pumping to achieve possibly lasing and measuring the electroluminescence of different devices at different temperatures.

Prior knowledge

Prior knowledge in the field of semiconductor engineering and photonics, as well as in the field of semiconductor technology is necessary. Basic knowledge on performing measurements is beneficial.

Organizational issues

The content of this work is flexible in terms of amount and requirements. It can be adjusted to suit for a bachelor-, research-, or master thesis.

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