Universität Stuttgart
Institut für Halbleitertechnik

# Qualification work

Bachelor thesis | Research thesis | Master thesis

## Fabrication and characterization of underetched GeSn microbridges for lasing applications

**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 $\alpha$-Sn leads to a decrease of the $\Gamma$- and $L$-valley. Due to the negative direct bandgap of $\alpha$-Sn the $\Gamma$-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 pseudomorphic on Si or Ge. To reduce the compressive strain, which leads to a reduction in the directness of the material, the GeSn can be underetched. Using microbridge structures enables to fabricate fully underetched GeSn layers with a high degree of relaxation and thus a high directness of the material.

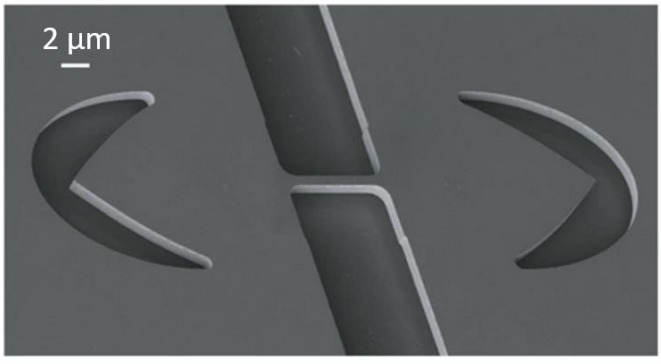


**Figure 1:** Tilted top-view of an underetched Ge microbridge.
Source: https://doi.org/10.1038/s41467019-10655-6

**Scope of the work**

The scope of this work is to fabricate and characterize underetched GeSn microbridges. The fabrication takes place in our institute cleanroom. The main part of this work is to develop, monitor and document the processes for to fabricate underetched microbridge resonators. After the fabrication, an intense electrical and electro-optical characterization should be done.

**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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