Master's Thesis:
Interband cascade infrared photodetectors based on InAs/GaSb superlattice absorbers

Technische Physik

We offer a master's thesis in the research group *nanoelectronics* at the chair **Technische Physik**.

Interband cascade infrared photodetectors (ICIP) [1],[2] employ type-II superlattices (SL) based on the InAs/GaSb/AlSb material system. The detector's sensitive wavelength range can be adjusted by changing the SL composition. This degree of freedom allows to measure infrared radiation between around 2-14 µm. This wavelength range is especially interesting for gas sensing applications in science and technology. The unique layer structure of ICIPs allows to measure a photocurrent without the need to apply an external bias voltage (photovoltaic operation). The multi-stage architecture reduces the device noise current which leads to a high signal-to-noise ratio.

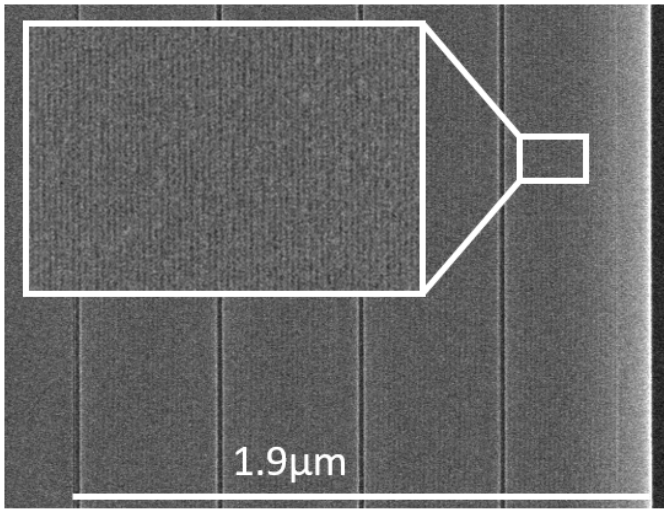

Fig. 1 *Scanning electron micrograph of a four stage ICIP. The zoomed in image shows multiple periods of n InAs/GaSb SL.*

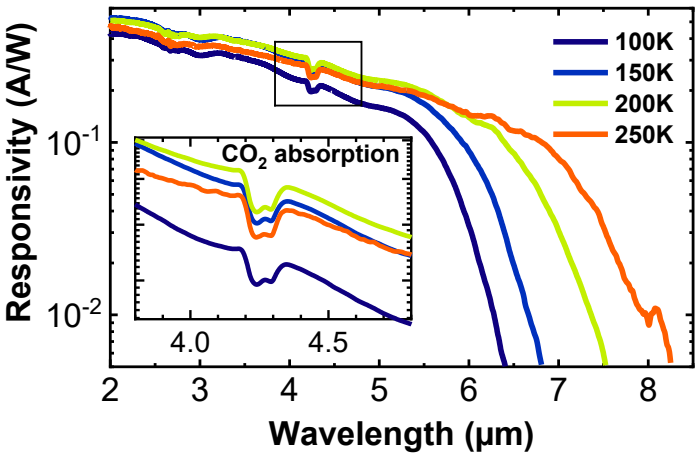

Fig. 2 *Spectral responsivity of a 7-stage ICIP under photovoltaic operation at temperatures between 100 and 250 K [3]. The inset shows absorption of ambient CO_2 at around 4.2 – 4.3 µm.*

Your tasks will include the optoelectronic characterization of different existing ICIP samples. Furthermore, you will support in designing and growing new ICIP structures using molecular beam epitaxy (MBE) in our chair's 550 m² clean room. You will be trained in various characterization techniques including XRD, SEM, AFM, PL etc.

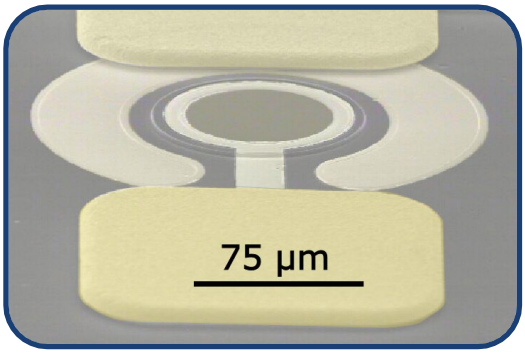

Fig. 3 *Processed ICIP mesa for measurements*

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References:

[1] J. Li et al., Interband cascade detectors with room temperature photovoltaic operation, *Applied Physics Letters* **86**, 101102 (2005)
[2] R. Yang et al., Interband-cascade infrared photodetectors with superlattice absorbers, *Journal of Applied Physics* **107**, 054514 (2010)
[3] A. Bader et al., Interband cascade infrared photodetectors based on Ga-free InAs/InAsSb superlattice absorbers, *Applied Physics Letters* **121**, 041104 (2022)