

Master's Thesis: CC-SiNOH Modulator

The silicon nitride (Si_3N_4) photonic platform offers very low optical losses and is therefore well suited for high-performance passive integrated components. However, Si_3N_4 lacks efficient mechanisms for electro-optic modulation, which limits its use in high-speed active photonic systems. Silicon-organic hybrid (SOH) modulators provide highly efficient electro-optic modulation with very low half-wave voltage–length products [1]. However, their resistive coupling mechanism between the microwave electrodes and the optical slot waveguide limits the bandwidth and is not applicable to Si_3N_4 . Capacitive coupling (CC) [2] is a promising approach to overcome this bandwidth limitation and simultaneously maintain a low π -voltage. This thesis focuses on designing and realizing a capacitive-coupled modulator integrated on the Si_3N_4 platform, combining low optical loss, high power handling capability, and broadband modulation performance.

Your tasks:

- Transferring the concept of CC-SOH modulators to the silicon nitride platform
- Electrical and optical simulation
- Improving the design of CC-SiNOH modulators
- Fabrication and characterization of new devices

For detailed information contact:

M.Sc. Alexander Kotz
alexander.kotz@kit.edu
Tel. 0721-608-42480

Prof. Dr. Christian Koos
christian.koos@kit.edu
Tel. 0721-608-42491

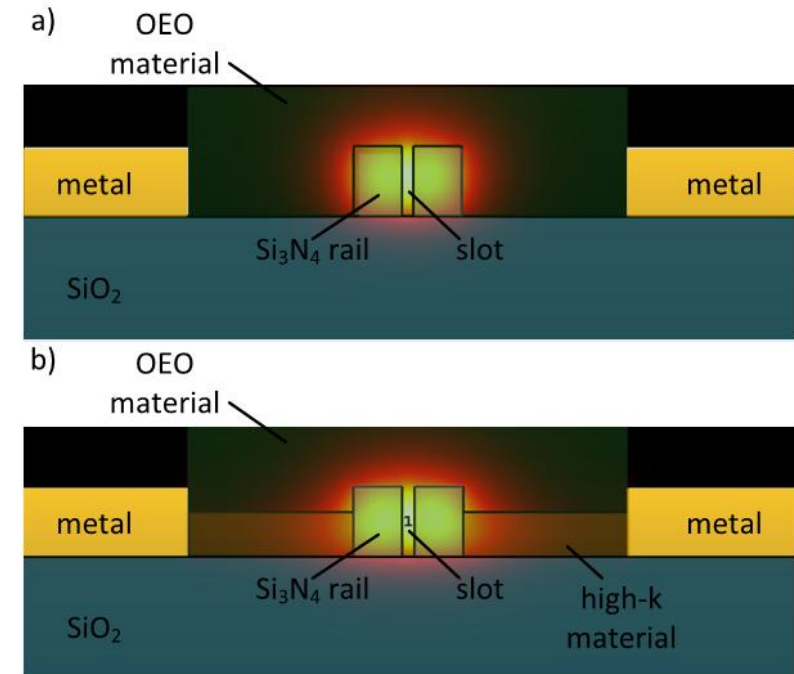


Fig. 1: CC-SiNOH modulator a) without and b) with high-k material between the metal electrodes and the slot-waveguide

[1] Kieninger *et al.*, “Ultra-high electro-optic activity demonstrated in a silicon-organic hybrid modulator,” *Optica*, vol. 5, no. 6, pp. 739-748, 2018.

[2] Ummethala *et al.*, “Hybrid electro-optic modulator combining silicon photonic slot waveguides with high-k radio-frequency slotlines,” *Optica*, vol. 8, no. 4, pp. 511-519, 2021.