

Design and application of silicon-organic hybrid (SOH) modulators

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Electro-optic modulators are important for realizing advanced functionalities of photonic integrated circuits (PIC). Such PIC are preferably fabricated on silicon using CMOS processing. However, silicon lacks a second-order nonlinear susceptibility and therefore a Pockels effect, preventing a native implementation of modulators. This deficiency is overcome when employing the plasma dispersion effect: Injecting or depleting carriers in a waveguide section changes its refractive index. However, silicon can be complemented with a Pockels-type organic electro-optic material that fills a silicon slot waveguide between its rails. An applied voltage changes the effective refractive index and thereby the phase of a propagating optical slot mode. Such SOH phase shifters form the arms of an interference-controlled highly efficient Mach-Zehnder modulator (MZM). We discuss the organic material's long-term stability, elaborate on the design of SOH MZM, and define performance metrics for comparing different modulator realizations. We also refer to unconventional applications, e. g., to an optical read-out for cryoelectronics.



Short Bio:

Wolfgang Freude is a Professor at the Institute of Photonics and Quantum Electronics, Karlsruhe Institute of Technology (KIT), Germany, a Distinguished Senior Fellow at KIT, and an Honorary Doctor of Kharkov National University of Radioelectronics. His research activities are in the area of optical and wireless high-data rate transmission, employing

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