**CONTROL ID:** 2391877
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**Abstract Details**

**PRESENTATION TYPE:** Oral Presentation Preferred
**CURRENT SYMPOSIUM:** EP7: Material and Device Frontiers for Integrated Photonics
**KEYWORDS:** Performance/Functionality/optoelectronic, Performance/Material Form/nanostructure, Composition & Microstructure/Chemical Element/Ge.
**Abstract**

**TITLE:** Novel Electro-Absorption Modulator with Germanium Fins Evanescently Coupled to Silicon Waveguide
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**ABSTRACT BODY:**
**Abstract Body:** Electro-Absorption (EA) modulator is a promising candidate for the next generation devices in Si photonics with even lower power consumptions for short-reach optical interconnections. However, its relatively higher insertion loss must be addressed, and the efficient coupling from a Si waveguide to EA modulator is a challenging topic. Here, we propose, for the first time, to use novel Ge fin structures for EA modulators. An array of Ge fins evanescently coupled to a Si waveguide is used for the modulation by the Franz-Keldysh effect (FKE). We have designed this new EA modulator using Ge fins based on simulations.

We consider a structure, where Ge fins are connected to heavily doped Si electrodes forming a lateral p-i-n diode. We will apply reverse bias to Ge fins to change the absorption coefficient by FKE. The width and pitch of fins were assumed to be 10-nm and 100-nm, respectively. The single mode Si waveguide with the width of 500-nm and the thickness of 200-nm was located on top of the Ge fins with the oxide of 10-nm in-between.

We assumed that the thickness of fin is to be 70-nm, which guarantees moderate mode overlaps from waveguide to the fin region. We have simulated the modulator operated on wavelength of 1550-nm under two application voltages of 3.3-V and 10-V. We simulated the modulators with different lengths up to 30-μm, and found that both of the insertion loss and the extinction ratio have a perfect exponential dependence on the length of the modulator. Based on this confirmation, we could safely extrapolate to identify the performance of the modulator for the longer length.

Assuming the length of 90-μm, under the drive voltage of 10-V, the proposed device has a remarkably low insertion loss of 0.43-dB and an extinction ratio of 3.31-dB. If we consider the lower drive voltage of 3.3-V, it has the insertion loss of 2.77-dB and extinction ratio of 3.58-dB at the modulator length of 600-μm. We think that the proposed EA modulator with Ge fins will be a promising candidate for compact optical interconnections by Si photonics.

This work is supported by EPSRC Standard Grant (EP/M009416/1), EPSRC Manufacturing Fellowship (EP/M008975/1), EU FP7 Marie-Curie Carrier-Integration-Grant (PCIG13-GA-2013-618116), University of Southampton Zepler Institute Research Collaboration Stimulus Fund, and Hitachi.