

Imec demonstrates broadband graphene optical modulator on silicon

December 16 2014, by Hanne Degans

At this week's IEEE International Electron Devices Meeting (IEDM 2014), nanoelectronics research center imec and its associated lab at Ghent University have demonstrated the industry's first integrated graphene optical electro-absorption modulator (EAM) capable of 10Gb/s modulation speed. Combining low insertion loss, low drive voltage, high thermal stability, broadband operation and compact footprint, the device marks an important milestone in the realization of next-generation, high-density low-power integrated optical interconnects.

Integrated optical modulators with high [modulation speed](#), small footprint and broadband athermal operation are highly desired for future chip-level optical interconnects. Graphene is a promising material to achieve this, owing to its fast tunable absorption over a wide spectral range. Imec's graphene-silicon EAM consists of a 50 μ m long graphene-oxide-silicon capacitor structure implemented on top of a planarized silicon-on-insulator (SOI) rib waveguide. For the first time, high-quality optical modulation was demonstrated in a hybrid graphene-silicon modulator, at bit rates up to 10Gb/s. A competitive optical insertion loss below 4dB and extinction ratio of 2.5dB were obtained over a broad wavelength range of 80nm around 1550nm center wavelength. Moreover, no significant changes in performance were observed for temperatures in the range of 20-49°C, implying a robust athermal operation. As such, imec's graphene-silicon EAM outperforms state-of-the-art SiGe EAMs on thermal robustness and optical bandwidth specifications.

"With this breakthrough result, imec has illustrated the huge potential of graphene optical EA modulators with respect to thermal, bandwidth, and footprint benefits," said Philippe Absil, 3D and Optical Technologies department director at [imec](#). "This achievement underscores our dedicated work and industry leadership in R&D on high bandwidth chip-level optical input/output. Future work will focus on further improving the modulation speed of our graphene EAM, similar to the speed obtained in highly optimized Si(Ge) modulators (30-50 Gb/s)."

Provided by IMEC

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