ETH Zurich and Polariton Technologies Achieve Record-Breaking Electro-Optic Bandwidth with Plasmonic Modulators

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Polariton Technologies AG, an ETH Zurich spin-off, together with ETH Zurich have set a new benchmark in the field of electro-optic (EO) modulators with their latest innovation.

"Ultra-Wideband MHz to THz Plasmonic Electro-Optic Modulator" – this study by Yannik Horst *et al.* showcases state-of-the-art plasmonic modulators that achieve an EO bandwidth extending into the terahertz (THz) range.

The team at ETH Zurich, led by Juerg Leuthold, has successfully demonstrated the frequency response up to 1.1 THz, with a 3-dB bandwidth of 997 GHz and a 6-dB bandwidth above 1 THz. These results of devices, manufactured by Polariton and characterized by ETH Zurich, showcase the team's commitment to pushing the boundaries of technology.

Dr. Yannik Horst, first author of the study, comments, "This achievement confirms the potential of plasmonic modulators to bring THz frequencies to photonic integrated circuits (PICs). For many years, its capability beyond 500 GHz was just theory." Building on the results of Burla *et al.* (APL Photonics, 2019), measurements up to 1.1 THz are now possible thanks to an optimized modulator design and improved electronics.

Dr. Wolfgang Heni, co-CTO of Polariton, adds, "These results show the vast usability of plasmonic modulators, from high-data-rate fiber communications to simple, linear, ultra-broadband THz receivers. The linear DC-to-THz bandwidth within a single device enables broadband field detection over a wide frequency range. Consequently, these devices open up numerous new applications in THz imaging, sensing, and wireless communications."

Key highlights:

- **Unprecedented EO Bandwidth:** Plasmonic modulators achieve an EO bandwidth ranging from 10 MHz to 1.1 THz, surpassing previous records and expanding the accessible EO frequency range to more than double that of earlier measurements.
- **Future-proof solution for 400G/lane and beyond**: Polariton's ultra-broadband EO modulators offer a technology for silicon photonics-based optical communication at and beyond 400G/lane.
- **Applications in THz Technology:** The modulators' unique suitability for THz PICs paves the way for advancements in wireless communication, sensing, and medical imaging.

- **Innovative Design:** The optimized modulator design addresses current limitations and proposes solutions for operation above 1 THz, highlighting the immense potential for future technological advancements.

Prof. Juerg Leuthold, head of the Institute of Electromagnetic Fields at ETH Zurich, states, "The successful demonstration of bandwidths beyond 1 THz marks a significant milestone in the field of photonics. It paves the way for new avenues in research and development, and we are excited about the potential applications that this breakthrough will enable."

The results are published in *Optica*, Optica Publishing Group's journal for high-impact research, available in open access: https://doi.org/10.1364/OPTICA.544016.

For direct inquires and personal exchange, Polariton is participating the OFC in San Francisco, the Laser World of Photonics in Munich and the ECOC in Copenhagen. Their offer includes Mach-Zehnder modulators and ring resonator modulators operating at 1310 nm and 1550 nm, as well as custom design service including plasmonic building blocks through their Process Design Kit.

About Polariton Technologies

Polariton is a Swiss designer and manufacturer of high-performance photonic integrated circuits (PICs) for ultra-high-bandwidth and low-power applications in communication, computing, test & measurement, space and quantum technologies markets. Exceptional performance is achieved by combining the established silicon photonics platform with plasmonic active devices enabling operation in sub-THz and THz regimes, in particular with Mach-Zehnder and ring resonator modulators.

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Freedom and individual responsibility, entrepreneurial spirit and open-mindedness: ETH Zurich stands on a bedrock of true Swiss values. Our university for science and technology dates back to the year 1855, when the founders of modern-day Switzerland created it as a center of innovation and knowledge. At ETH Zurich, students discover an ideal environment for independent thinking, researchers a climate which inspires top performance. Situated in the heart of Europe, yet forging connections all over the world, ETH Zurich is pioneering effective solutions to the global challenges of today and tomorrow.

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