# Gate-controlled graphene pn-junction for integrated photodetection

**Simone Schuler**[1], Daniel Schall[2], Daniel Neumaier[2], Lukas Dobusch[1], Ole Bethge[3], Benedikt Schwarz[3], Michael Krall[1], and Thomas Mueller[1]

[1]TU Wien, Institute of Photonics, Gußhausstraße 27-29, 1040 Vienna, Austria
[2]AMO GmbH, Otto-Blumenthal-Straße 25, 52074 Aachen, Germany
[3]TU Wien, Institute of Solid State Electronics, Floragasse 7, 1040 Vienna, Austria

*simone.schuler@tuwien.ac.at*

The research in the field of integration of photonic components on a single chip, favourable silicon, is picking up speed in order to keep pace with the continually increasing amount of data consumption.

Photodetectors convert light into electrical signals and are the heart of any optical link. In silicon photonics, typically Germanium or III – V semiconductors are used as detection materials but both material systems have limitations. Graphene, with its ultra-broadband absorption, high carrier mobility and gate tuneability make it an attractive candidate for high-speed integrated photonics. Here, we present a tuneable pn-junction graphene photodetector relying on the photo-thermoelectric effect [1]. The slot-waveguide structure allows the use of the silicon strips as dual-gate electrodes to create a pn-junction and at the same time it allows to confine the guided light to subwavelength dimensions [2]. A responsivity of 35mA/W is reached at zero-bias, where the photo-thermoelectric effect is the dominant conversion mechanism. By applying a bias voltage, a responsivity of 76mA/W is reached due to an additional photoconductive contribution. A key indicator of a detector's performance is its electrical bandwidth. The photoresponse of photodetectors based on the photo-thermoelectric effect arises from hot electrons, rather than lattice heating. Thus, electrical measurements resulted in a setup-limited 3-dB bandwidth of 65 GHz, which is the highest value as yet, reported for a graphene-based photodetector [3].

## References

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## Figures

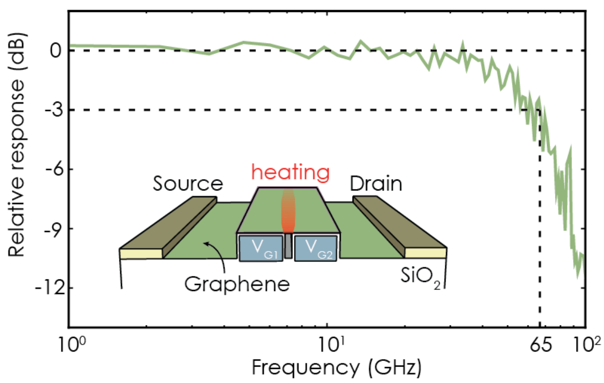


**Figure 1:** Measured frequency response using a heterodyne technology. Inset: Sketch of the device structure.