# Terahertz imaging of optically modulated graphene layers

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Terahertz (THz) imaging systems are currently one of the most attractive tools in many types of applications [1]. Real implementation require that all systems elements, both active and passive, would be compact and convenient in use.

Exceptional properties of graphene [2] make it attractive for a large variety of THz applications, including, for instance, production of diffractive optical elements, filters or modulators. However, this approach stimulates a strong need to develop characterization techniques – preferably contactless – to control properties and quality of this material.

In this work, it was demonstrated that optical modulation [3] together with simultaneous terahertz (THz) imaging application enables characterization of samples based on single and double layer graphene transferred on a high resistivity silicon (Si) substrate.

It was demonstrated that an optical excitation applied simultaneously with THz imaging allows to increase a contrast by an order of magnitude illustrating that the technique can be found as convenient contactless tool for characterization of graphene deposited on high-resistivity silicon substrates. Furthermore, it was shown that the single- and double-layer graphene can be discriminated and characterized via variation of THz image contrast using a discrete frequency in a continuous wave mode. Modulation depth of 45 % has been reached, the contrast variation from 0.16 up to 0.23 is exposed under laser illumination for the single and double layer graphene, respectively (see Fig.1).

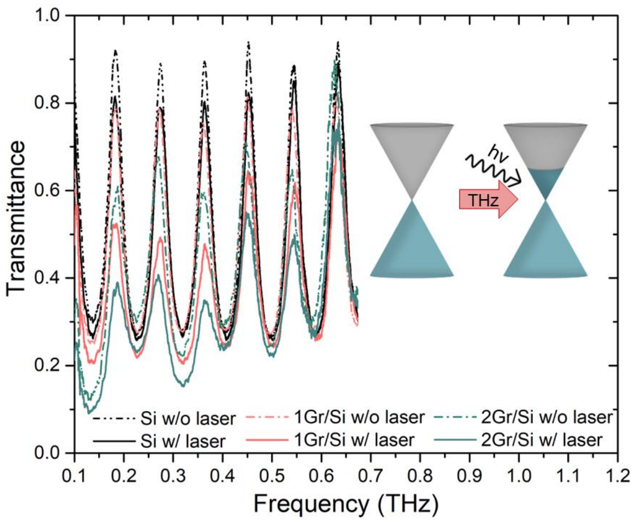


Fig.1. Transmittance spectrum of bare Si, single and double graphene layers. Inset depicts graphene's Dirac cones before and after photoexcitation.

Possibilities to apply the technique for investigation of graphene-based THz diffractive elements will be illustrated in addition.

## References

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