Graphene-based THz antennas for ubiquitous communication devices

Compact antennas are a key determinant for the performance of all future ubiquitous smart devices. Graphene plasmonic micro-antennas with lateral dimensions of just a few micrometers can theoretically have area requirements up to four orders of magnitude smaller than classical metallic counterparts, indicating a huge potential, enabling radically miniaturized wireless communications, providing better integration at much lower cost.

Graphennas have been extensively analyzed theoretically. It seems therefore astonishing, that such a high impact potential application does not have any experimental proof as an integrated THz source. This absence does not result from the integration complexity: The real use of this concept is obstructed from a fundamental point of view as the envisaged huge advantages of graphennas degrade with realistically integrable graphene. Fundamentally better understanding of plasmonic transport in the THz frequency range is required to assess the true application potential of graphennas.

The objective of the project is to pave the way for a widespread industrial take-up of graphene based plasmonic antennas, addressing:

- **An experimental prototype demonstration which shows and assesses the practical operation of a graphenna.** Here, photoconductive emitters based on THz graphennas will be demonstrated. A reduction of antenna length by a factor of 10 is envisaged and tunability will be demonstrated.
- **Detailed understanding of limiting performance factors of such a graphenna, under realistic technologically achievable parameters will be developed.** Here, a close analysis of measured electronic transport parameters, microwave modelling of the antenna characteristics under such transport parameters and correlation with experimental graphenna performance will be used to ascertain the potential and limitations for graphenna operation at THz and lower frequencies.
- **Fundamental understanding of the microscopic origin of these limitations will be achieved, in order to guide graphene material optimization in the context of this and other THz applications.** For this purpose, microscopic theory will be used to assess the influence of different scattering mechanisms and the role of different substrates on the THz conductivity in graphene. Careful comparisons with experiments will indicate which material parameters need to be tuned to maximize graphenna performance.

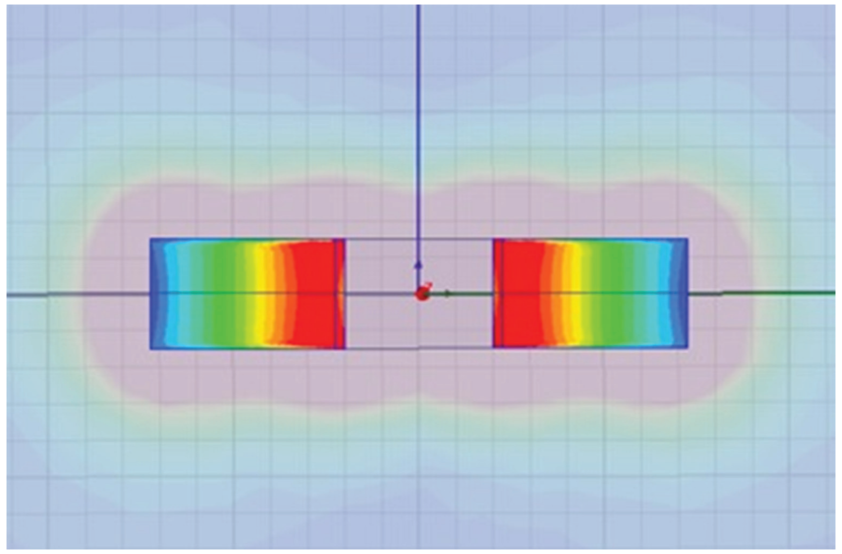
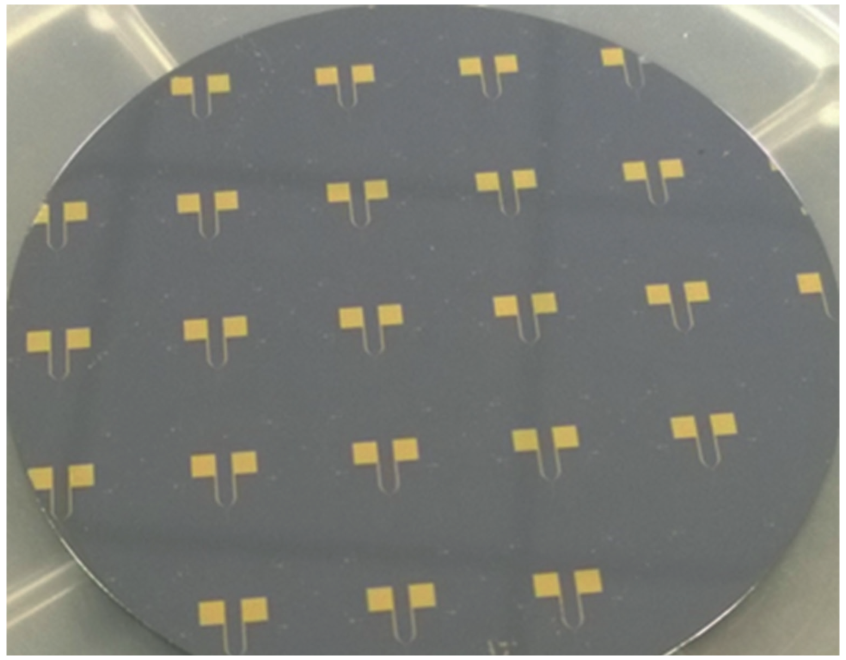


Figure 1: Current distribution in antenna

Figure 2: Structured wafer with multiple antennas



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