Development of a Cost-effective Graphene-Based Terahertz Transceiver for Ultrafast Indoor Communication

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Next-generation wireless communication technologies, such as 6G, heavily rely on terahertz (THz) frequencies due to their high-frequency operation and broad bandwidth capabilities. However, the widespread adoption of THz systems is hindered by the high production costs and material inefficiencies associated with conventional THz transceivers, typically based on expensive metals like gold (Au). This project aims to develop a cost-effective alternative by comparing graphene-based THz transceivers to traditional metal-based counterparts, with the objective of significantly reducing both material and production costs. To explore the practicality of THz communication in indoor environments, wall material analysis was conducted. GaAs photoconductive antennas were fabricated using photolithography, and graphene electrodes were spray-coated, marking the first implementation of this technique. Furthermore, signal wall propagation was examined utilizing terahertz time-domain spectroscopy (THz-TDS). Material analysis reveals that gypsum board material allows for 91% signal transmission, while cement allows for 16.5%. The results indicate that the proposed approach decreases costs by 97% relative to commercial Au/GaAs THz antennas, while preserving photoconductivity performance at 85-97% of the original design, as assessed by electrical resistance. These findings not only reduce costs but also enable more efficient and widespread implementation of THz technology in practical applications, making ultra-fast communication systems potentially more feasible for global adoption.

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