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| **Abstract:** |  |
| The demand for high data rates in wireless communication is steadily increasing. To fulfill the requirements, 6G will play a vital role, and it can be achieved by a wide range of spectrums. So, to overcome the data rate problem, in this research, a graphene-based antenna is designed for 6G communication. The performance of the antenna is improved by minimizing the return loss of the antenna. The design incorporates graphene, a two-dimensional material, into the patch structure of the antenna. Various substrates, including FR4, Rogers RO3003, and Rogers RO3010, have been considered, and the antenna dimensions are fixed at 15 × 20 µm 2 . Upon comprehensive analysis, the outcomes reveal particularly promising results for the FR4 substrate, demonstrating a return loss of -67.87 dB at 8.704 THz. However, the most notable performance is observed with the Rogers RO3003 substrate, showcasing an impressive return loss of -75.92 dB at 8.552 THz, coupled with a VSWR value of 1.0003198. The comprehensive design was carried out using CST Studio. These findings position the proposed antenna as an optimum choice for a range of applications, including short-range high-frequency communication, terahertz imaging and sensing, airspace communication, and healthcare applications. | |