

Advancements in Metamaterial Design for Terahertz Applications

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Abstract—Provide a concise summary of your work in 50 words maximum. Do not include any symbols, special characters, or math in the paper's title or abstract. The abstract should appear immediately below the authors' names and corresponding author contact information.

Keywords—metamaterials, terahertz, machine learning, photonic crystals.

I. INTRODUCTION

Metamaterials have revolutionized electromagnetic wave control. The growing demand for advanced terahertz technologies necessitates innovative material design approaches.

II. METHODS

Our methodology integrates simulation, optimization algorithms, and experimental feedback:

$$\epsilon_{\text{eff}}(\omega) = \sum_{n=1}^N \frac{f_n \omega_n^2}{\omega_n^2 - \omega^2 - i\gamma_n \omega}, \quad (1)$$

where ϵ_{eff} denotes the effective permittivity, f_n the oscillator strength, ω_n the resonant frequency, and γ_n the damping factor.

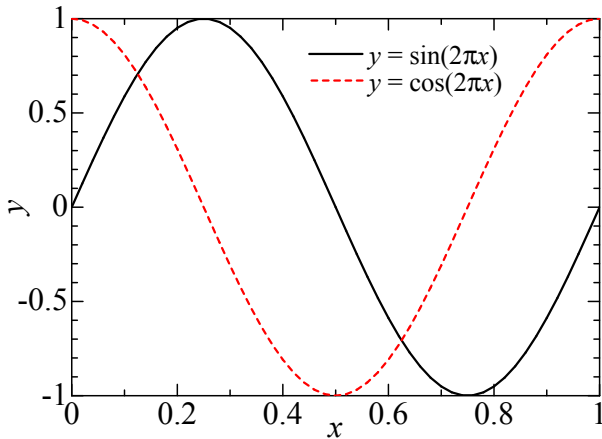


Fig. 1. Unit cell geometry of the proposed metamaterial.

III. RESULTS AND DISCUSSION

Experimental results show:

- 92 percent absorption at 0.8 THz
- 40 percent broader operational bandwidth than conventional THz absorbers
- Strong agreement between simulated and measured spectra (Fig. 1)

IV. CONCLUSION

We have demonstrated a THz metamaterial with superior wavefront control and broadband absorption. Future work will extend the design to polarization-independent and reconfigurable THz devices.

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REFERENCES

- [1] J. A. Doe, R. B. Roe, and M. C. Poe, "Controlling electromagnetic fields in metamaterials," *Journal of Imaginary Physics*, vol. 1, pp. 100–110, 2020.
- [2] X. F. Smith and Y. T. Lee, "Terahertz metamaterials: design and applications," *Fictional Photonics Letters*, vol. 5, pp. 50–60, 2021.
- [3] A. N. Author, B. S. Writer, and C. Q. Researcher, "Machine learning for photonic crystal optimization," *Journal of Made-Up Science*, vol. 12, pp. 200–215, 2019.