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Design of terahertz photoconductive antennas array using cross-fingers structure to enhance output power

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Today, terahertz technology in the field of communication and wireless information transmission has been able to create important capabilities. Hence it has become a significant issue for research. One of these is the strengthening of the terahertz antenna as a powerful transmitter in the field of transmission and communication. The purpose of this research is to design terahertz photoconductive antenna arrays to enhance their output power. The arrays were designed based on cross-fingers structure as a high power terahertz generator. The finite difference time domain method was used for modeling and simulating of the generator. The characteristics of the array and its emphasis points and key parameters were studied. This structure demonstrated that the terahertz antenna array can generate drastically increased terahertz field amplitudes compared to other structures. The output power of the array enhanced as large as 74.1 μW. The array enhances the terahertz output power for use in extensive terahertz science and technology applications such as satellite communication and high speed wireless contact.

Methodology & Theoretical Orientation: Photoconductive (PC) antenna is the prevalent device for the generation of THz waves, because it has many advantages. The power efficiency of PC antenna is not restricted which is its main advantage compared to other devices. It is still interesting for researchers to generate enhanced power THz using PC antenna. Expansion of the THz-PC antenna applications depends on enhancement of its output power. Hence, researchers have focused on improving the output power by designing varieties of THz-PC antennas. The low power efficiency of THz-PC antennas is their main limitation, so that enhancement of their power is an issue in all scales. Configuration of THz-PC antenna in an array is a usual method to overcome this limitation.

Findings: Consequently, the results showed that the improved array could increase the THz output power compared to other arrays under similar conditions. The simultaneous use of circular arrangement and cross-finger structure in the proposed array, which is the novelty of this work, improves the THz output power of the array in comparison with other arrays.

Conclusion & Significance: In summary, an improved structure has been presented for a THz antenna array device to enhance the output power of THz radiation. The cross-fingers structure used in this array is based on a circular design. The output peak power of the array was estimated to be 74.1 μW at 0.4 THz. The THz output power of the improved array enhanced larger than that of the other arrays without cross-fingers structure. The cross-fingers structure array demonstrated that the THz antenna can generate drastically increased THz field amplitudes compared to those of other structures. The improved array remains in an unsaturated region of operation, whereas the optical pumping with high power level and beam focus was used for its excitation. Therefore, the simultaneous use of circular arrangement and cross-fingers structure in the array of photoconductive antennas can enhance the optical-to-THz conversion efficiency and thus improve the THz output power of the array.