A powerful THz radiation source based on a diamond photoconductive antenna

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Diamond doping has enabled the use of commercially available femtosecond (fs) infrared lasers for optical pumping of photoconductive antennas (PCAs) instead of complex UV fs lasers for generating photocarriers in pure diamond. However, the demonstrated power of the generated terahertz radiation is still far from the maximum achievable level. The main limiting factor is that the electrodes generating the electric field in the diamond substrate are located on the diamond surface, and the bias voltage level is limited by electrical breakdown across the diamond surface (20 kV/cm). Such antennas do not utilize the potential of the diamond substrate to achieve peak power. Their parameters do not exceed those of antennas made of narrow-gap semiconductors. Increasing the peak power requires the implementation of multipole antennas, i.e., antennas containing multiple emitters over a large area. A multiple increase in the THz radiation intensity is achieved by reducing the distance between the electrodes in each dipole and, correspondingly, increasing the intensity of the static electric field. To utilize the full potential of diamond, it is necessary to create conductive structures inside the diamond bulk and operate without exceeding the record breakdown threshold of 10 MV/cm. This work demonstrates the possibility of embedding conductive structures into the diamond bulk to significantly increase the electric field in the antenna. This research was funded by the Russian Science Foundation, grant number 25-19-00796, https://rscf.ru/en/project/25-19-00796/.