174. Title: Frequency-tunable terahertz electromagnetic wave emitters based on undopal GaAs/n-type GaAs epitaxial layer structures utilizing sub-picosecond-range carrier-transport processes

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Abstract: We have investigated sub-picosecond-range carrier-transport processes in undoped GaAs/it-type GaAs (i-GaAs/n-GaAs) epitaxial layer structures with various i-GaAs-layer thicknesses d ranging from 200 to 2000 nm, focusing on the relation between carrier-transport processes and terahertz electromagnetic wave frequency. Initially, using numerical simulation and photoreflectance measurement, we confirm that a decrease in d enhances the built-in electric field in the i-GaAs layer. In the time-domain terahertz waveform, it is observed that the intense monocycle oscillation induced by the surge current of photogenerated carriers, the so-called first burst, is followed by the oscillation patterns originating from the coherent GaAs longitudinal optical (LO) phonon. From the Fourier power spectra of the terahertz waveforms, it is clarified that the decrease in d causes a high frequency shift of the band of the first burst. Consequently, we conclude that, in the sub-picosecond time range, the photogenerated carriers are monotonously accelerated by the built-in electric field without being affected by intervalley scattering. The present conclusion signifies that the frequency-tunable terahertz emitters are realized by controlling i-GaAs-layer thickness. We also find the intensity of the coherent LO phonon band is enhanced by a decrease in d.