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Title

Terahertz spectroscopy of dynamics of coupling between the coherent longitudinal optical phonon and plasmon in the surge current of instantaneously photogenerated carriers flowing through the i-GaAs layer of an i-GaAs/n-GaAs epitaxial structure

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Abstract

We demonstrate the dynamics of coupling between the coherent longitudinal optical (LO) phonon and plasmon of instantaneously photogenerated electrons in an undoped GaAs/n-type GaAs (i-GaAs/n-GaAs) epitaxial structure using time-domain terahertz spectroscopy. Initially, we experimentally and numerically clarify the presence of the built-in electric field in the i-GaAs layer of the i-GaAs/n-GaAs epitaxial layer. Next, we performed the terahertz-wave measurements of the i-GaAs/n-GaAs epitaxial structure at various excitation conditions from a low density excitation regime to a high excitation regime. The LO-phonon-plasmon coupled (LOPC) mode has been confirmed from the terahertz-wave measurement. It is found that the frequency of the LOPC mode is determined by the pump-beam power. This fact demonstrates that the LOPC mode is formed in the i-GaAs layer. In addition, we performed the time-partitioning Fourier transform in order to reveal the dynamical change in the LOPC mode as a function of time delay. Using this analysis, we have observed that the disappearance of the LOPC mode immediately occurs within the time delay of 0.6 ps. Following the disappearance of the LOPC mode, only the bare coherent GaAs LO phonon dominates the terahertz waves. (23 References).