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# Effects of varying tensile strain on the THz emission from epitaxially-lifted gallium arsenide quantum wells bonded onto flexible plastic substrates

Strain can change the physical and electrical properties of semiconductors. While strain can induce defects on semiconductors, its impacts are not always negative. Strain has been incorporated into semiconductor heterostructures to produce long wavelength (˜1.55 μm) gallium arsenide (GaAs) based lasers. The changes that strain can make on semiconductor electrical properties in particular allow for modulation of the band structure in GaAs-based bulk films and nanostructures such as quantum wells. This modulation in turn affects processes governed by photo-induced charges in the semiconductor crystal and may affect charge-reliant processes such as emission of Terahertz (THz) radiation.

In this work, the effect of varying tensile strain on the THz emission of AlGaAs/GaAs quantum wells is investigated. The quantum wells were grown using molecular beam epitaxy over an aluminum arsenide (AlAs) layer on a semi-insulating GaAs substrate. The AlAs was then etched away in diluted hydrofluoric acid to release the ˜1 μm thin film from its host substrate. The film was then bonded onto a flexible plastic sheet using surface tension forces. Photoluminescence spectroscopy was then performed on the bonded film as the plastic sheet was mechanically bent to induce varying levels of tensile strain. The PL shows that as the film is being bent, the band structure of the quantum wells effectively redshift by energies up to 13 meV relative to the unbent case. Reflection-mode THz time domain spectroscopy (TDS) was also performed while bending the sample and shows that the THz emission intensity from the sample is enhanced up to ˜20% relative to the unbent case. These results demonstrate that modulation of the band structure of GaAs quantum wells via strain can strengthen the THz emission from these heterostructures.

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