Si (100)基板上に転送したGaNエピタキシャル層の残留応力評価

Residual stress evaluation of GaN epitaxial layers transferred onto Si (100) substrate

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[Introduction] GaN based power devices have been fabricated on SiC, sapphire, and Si substrates.[1] The output power densities of the devices are limited by the thermal conductivities of the substrate materials. If it is possible to transfer the GaN epitaxial layer onto diamond substrate with the highest thermal conductivity among materials, which would largely increase the output power density of the devices. In this work, we explored the transfer process of GaN epitaxial layer and investigated the residual stress of the GaN transferred onto Si (100) substrate.

[Experiments] GaN layers grown on Si (111) substrates were directly bonded to Si (100) substrates by SAB at room temperature.[2] After bonding, Si (111) substrates were removed by mechanical polishing and chemical vet etching. Raman mapping measurements were performed on the GaN layers for an area of 40 × 40 μm^2 with a step of 2 μm using a Renishaw InVia system with a 488 nm Argon laser.

[Results] Figure 1 shows Raman mapping of the GaN epitaxial layers transferred onto Si (100) substrates and grown on Si (111) substrates. The averaged Raman peak position is observed to be 566.999 and 567.134 cm^{-1} in the transferred GaN epitaxial layers and the grown GaN epitaxial layers, respectively. The Raman peak position of the transferred GaN layers is shifted to 0.135 cm^{-1} to lower wavenumbers, relative to that of the grown GaN layer. The stress relaxiation is observed in the transferred GaN layers with respect to the standard value of 567 cm^{-1} for unstressed GaN.

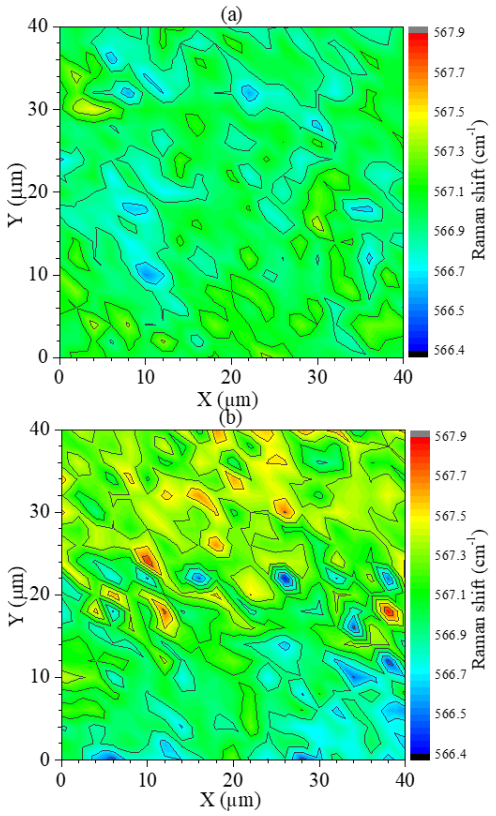

Fig. 1 Raman mapping of the GaN epitaxial layers transferred onto Si (100) substrates (a) and grown on Si (111) substrates (b).

[1] Y.-F. Wu, et al. IEEE Electron Device Lett. 25, 117 (2004).

[2] J. Liang, et al. Appl. Phys. Express 6, 021801 (2013).