

Bonded compliant substrate for epitaxy high brightness light emitting diodes

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The heteroepitaxy integration of III-V semiconductor compound, which was limited by the lattice mismatch, now can be accomplished by using bonded compliant substrate. In this study, an n-type GaAs (100) wafer, which was coated with $\text{In}_{0.5}\text{Ga}_{0.5}\text{P}$ /GaAs/ $\text{In}_{0.5}\text{Ga}_{0.5}\text{P}$ epitaxial films, was bonded to an n-type GaP (100) optical transparent substrate for fabricating high brightness light emitting diodes (LEDs). The detail bonding processes are shown in Fig. 1. Line patterns were first formed on the top of $\text{In}_{0.5}\text{Ga}_{0.5}\text{P}$ layer. Wafers were brought together at room temperature. The wafers were bonded at 740 °C for 1 hour in Ar ambience, and then the GaAs substrate and $\text{In}_{0.5}\text{Ga}_{0.5}\text{P}$ were removed by wet chemical etching. As shown in Fig. 2, no void was observed at bonded interface of line-patterned sample. However, lots of voids were found in the areas without line pattern. As shown in Fig. 3, these bonded films were not separated after the dicing process. The well-bonded substrates were used as the compliant substrate for epitaxy high brightness LED.

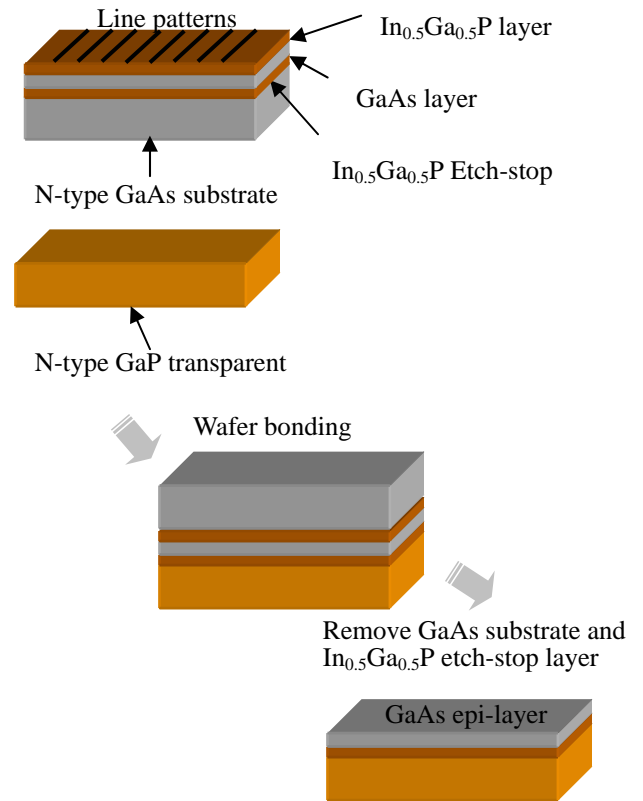


Fig. 1 Process flow of bonded compliant substrate

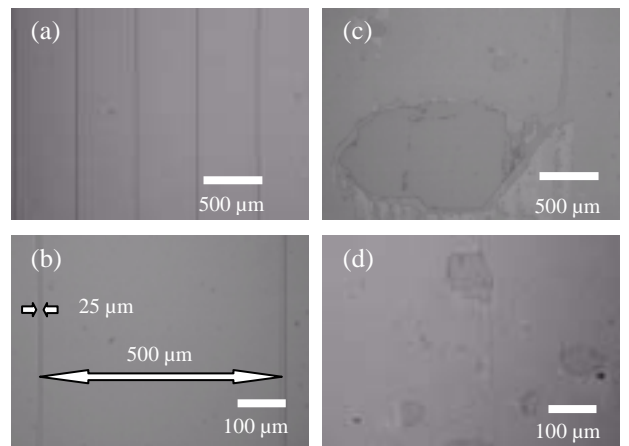


Fig. 2 Optical microscopic image of bonded interface after removing GaAs substrate and etching stop layer in areas with line patterns (a, b) and without line patterns (c, d).

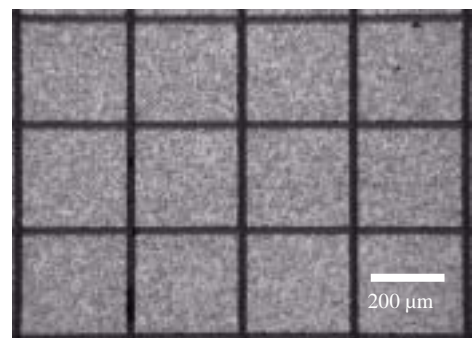


Fig. 3 Optical microscopic image of diced wafer after removing GaAs substrate and etching stop layer (the top layer is Au/Ge/Ni film for estimation of electrical characteristics)