(113)B GaAs 基板上の副格子交換による GaAs/AlAs 多層膜結合共振器

A GaAs/AlAs coupled multilayer cavity grown on (113)B GaAs with sublattice reversal

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We have shown that the $\chi^{(2)}$ (second-order nonlinear susceptibility) inversion technique introduced by face-to-face wafer bonding is useful in the construction of THz emitters based on the difference-frequency generation in a coupled multilayer cavity on a high-index (113)B GaAs substrate [1]. However, it should be noted that it is difficult to obtain equivalent optical thickness of two cavity layers grown on two substrates separately. Moreover, a lot of time and effort have to be spent on completely removing one side of bonded GaAs substrates by mechanical polishing and selective wet etching. Therefore, sublattice reversal (SR) epitaxy which results in $\chi^{(2)}$ inversion without wafer bonding, is expected to be an alternative and more versatile growth technique for THz device. In fact, Koh *et al.* have reported SR in GaAs/Ge/GaAs system on low-index (001) and (111) GaAs substrate [2]. We have recently demonstrated SR in GaAs/Ge/GaAs on a high-index (113)B GaAs substrate[3].

In this study, a GaAs/AlAs coupled multilayer cavity structure with SR was grown on (113)B GaAs by molecular beam epitaxy (MBE). Figure 1 shows cross-sectional scanning electron microscopy (SEM) of the sample, which consists of two equivalent GaAs cavity layers and three distributed Bragg reflector (DBR) multilayer. The Ge layer was insert in the middle of intermediate DBR for SR. Smooth GaAs/AlAs interfaces were formed over the entire region of the coupled multilayer cavity structure both below and above Ge layer. Two reflection dips corresponding to the cavity modes were clearly observed at ~1.5 μm as shown in Fig. 2. The frequency difference was ~2.8 THz.

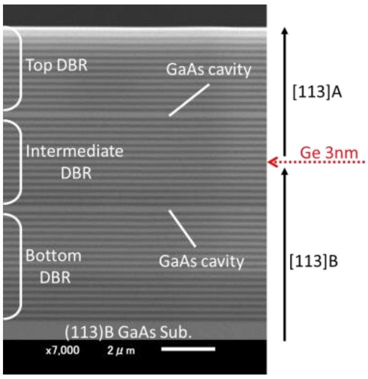

Fig. 1. Cross-sectional SEM image.

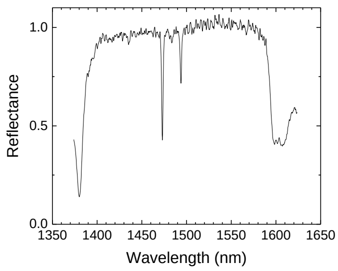

Fig. 2. Reflection spectrum.

[1]. T. Kitada *et al.*, APL 102, 251118 (2013). [2]. S. Koh *et al.*, JJAP 38, L508-L511 (1999).

[3] 盧 翔孟 他, 2016 年度 第 77 回応用物理学会秋季学術講演会, No.15a-P11-13.