Propagation properties of amplified magneto-surface-acoustic-wave by electron bunching

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A magneto-surface-acoustic-wave (MSAW) device [1] controls the phase velocity of surface acoustic wave (SAW) continuously by an external magnetic field, which attributes the delta E effect. It is constructed of a magnetostrictive film on a propagation path of the wave. Although the MSAW device is expected to be a phase modulator, it has the disadvantage that the eddy current loss in the conductive magnetostrictive film becomes large in the region of high driving frequency. On the other hand, when careers in a semiconductor thin film that is deposited on the propagation path are accelerated by external electric field, the SAW is amplified by means of electron bunching as the traveling-wave tube. In this study, we investigate to amplify the MSAW using a semiconductor thin film with large electron mobility An InSb semiconductor thin film was deposited on a 128° Y-X $LiNbO_3$ substrate by an ion beam sputter system. After annealing the sample at 535 °C for 60 minutes in vacuum, the (111)-oriented InSb thin film with an electron mobility of 1100 cm^2/Vs was obtained. A $Fe_{80}B_{20}$ amorphous thin film as the magnetostrictive material was deposited on the InSb thin film by a magnetron sputter system. In order to remove tension in the magnetostrictive film and to possess an in-plane magnetic anisotropy, the $Fe_{80}B_{20}$ amorphous thin film was annealed at 200 °C for 60 minutes in vacuum with a magnetic field of 400 Oe. An interdigital transducer with a strip width of 8 μm was fabricated by photolithography. We observed the SAW of 125 MHz in our fabricated MSAW device that had the hybrid structure of $Fe_{80}B_{20}$/InSb thin films on the $LiNbO_3$ substrate.

References

[1] N. Yokokawa, S. Tanaka, M. Inoue and T. Fujii, Jap. J. Appl. Phys., **Suppl. 30-1**, 182 (1991).