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Novel SAW Properties of Semipolar (103) AlN Films on Silicon

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ABSTRACT

In this research, (103) AlN films were combined with silicon to be a new composite surface acoustic wave (SAW) substrate. The theoretical SAW properties of (103) AlN films on silicon with four composite structures (interdigital transducer, IDT/(103) AlN/silicon, AlN/(103) IDT/silicon, IDT/(103) AlN/metal/silicon and metal/AlN/IDT/silicon) were completely analyzed. The simulation results showed the maximum electromechanical coupling constant (K2) of (103)AlN/silicon surpassed the ones of (002)AlN/silicon. The maximum K2 was 0.75% with the velocity (5079 m/s) at films thickness ratio (0.49) for metal/(103) AlN/IDT/silicon.

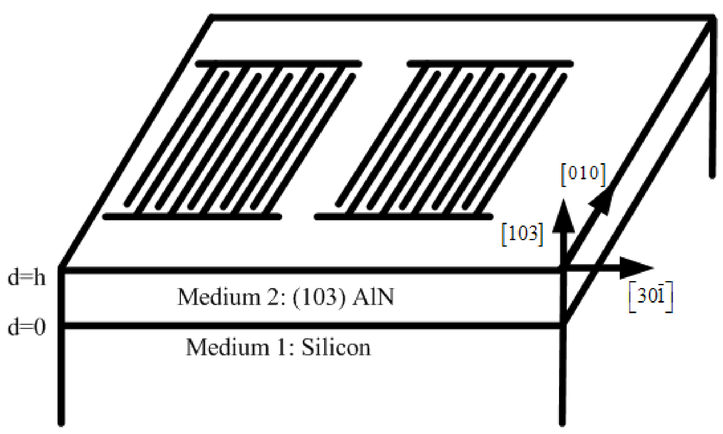

Fig. 1 The schematic figure of a layered piezoelectric structure

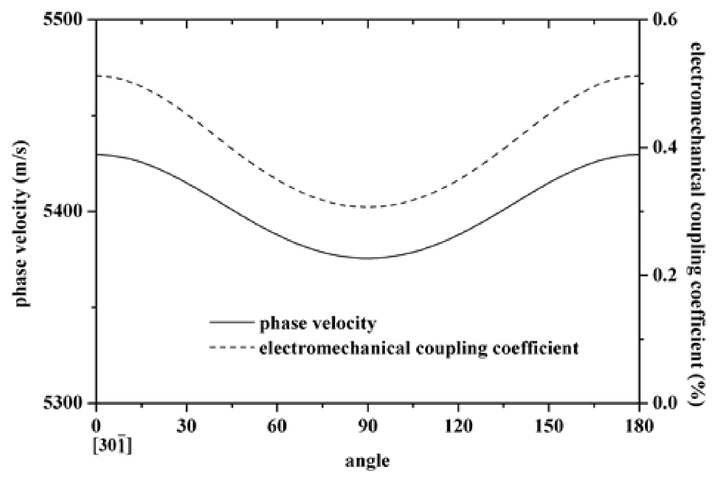

Fig. 2 The phase velocities and the K2 for the SAW propagation on infinite (103) AlN films

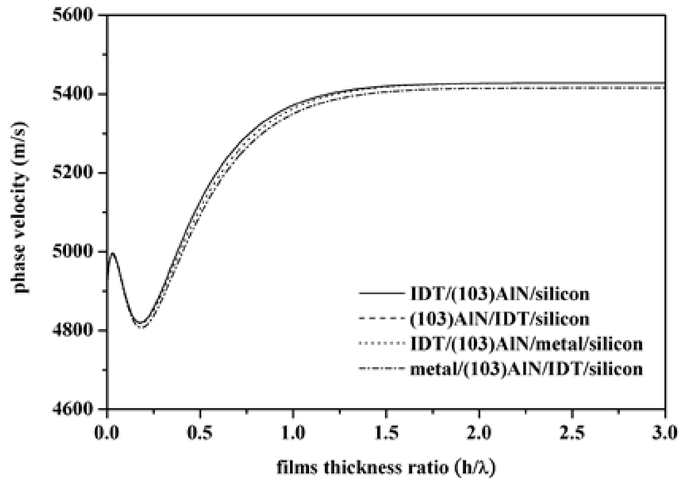

Fig. 3 The phase velocity dispersion curves of SAW propagating in the four structures (IDT/(103)AlN/silicon, (103)AlN/IDT/silicon, IDT/(103)AlN/metal/silicon, and met

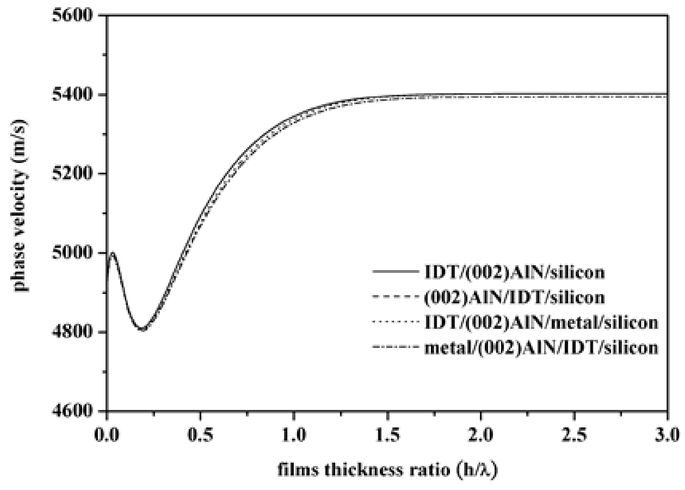

Fig. 4 The phase velocity dispersion curves of SAW propagating in the four structures (IDT/(002)AlN/silicon, (002)AlN/IDT/silicon, IDT/(002)AlN/metal/silicon, and metal/(002)AlN/IDT/silicon)

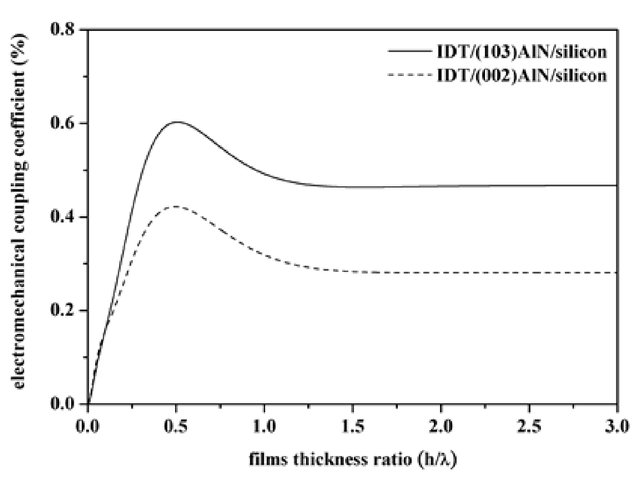

Fig. 5 The K2 dispersion curves of IDT/(103)AlN/silicon and IDT/(002)AlN/silicon

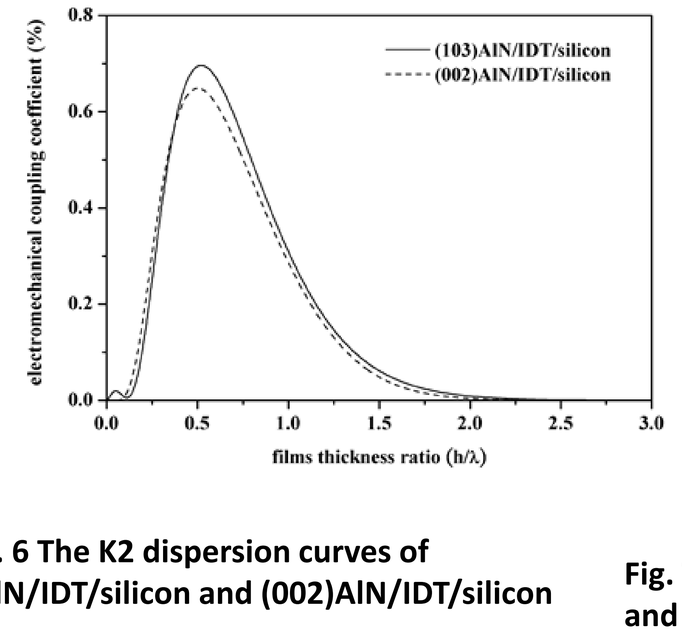

Fig. 6 The K2 dispersion curves of (103)AlN/IDT/silicon and (002)AlN/IDT/silicon

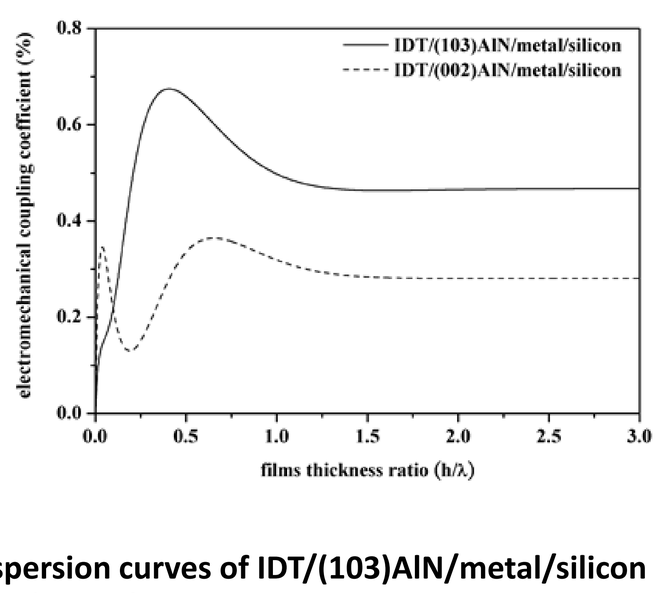

Fig. 7 The K2 dispersion curves of IDT/(103)AlN/metal/silicon and IDT/(002)AlN/metal/silicon

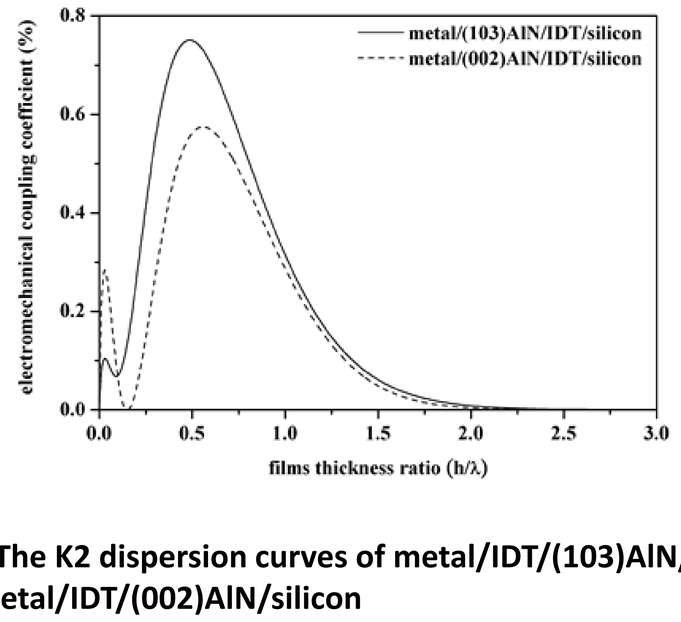

Fig. 8 The K2 dispersion curves of metal/IDT/(103)AlN/silicon and metal/IDT/(002)AlN/silicon

Conclusions

1. The SAW properties of (103) AlN films on silicon with four composite structures (IDT/AlN/silicon, AlN/IDT/silicon, IDT/AlN/metal/silicon and metal/AlN/IDT/silicon) were theoretically analyzed. The simulation results showed the maximum K2 of the (103)AlN/Si surpassed the ones of the (002)AlN/Si. The maximum K2 was 0.75% with the velocity (5079 m/s) at h/ =0.49 for metal/AlN/IDT/silicon. Those research results provide a predictable and theoretical basis for further application on SAW devices.