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Title:	**Sc doped AlN: A new piezoelectric thin film for SAW sensor applications**
Abstract:	Wireless and batteryless sensors based on surface acoustic wave (SAW) technology have been paid much attention for the use in harsh environment. As the piezoelectric substrate, $LiNbO_3$ and $LiTaO_3$ have been used because of their high electromechanical coupling factor K^2 determining achievable device insertion loss and passband width. Since the SAW velocity V on these substrates is relatively low (<4,000 m/s), piezoelectric materials with large V and K^2 are strongly demanded for the operation in multi GHz range. Although AlN may seem feasible for the purpose, achievable K^2 is limited. This talk is aimed at discussing applicability of $Sc_rAl_{1-r}N$ for the SAW sensor applications. Piezoelectric $Sc_rAl_{1-r}N$ films can be deposited by the dual radio frequency magnetron reactive co-sputtering using metal Sc and Al targets. Deposited films are chemically inert, and thermally quite stable. It is interesting that they are paraelectric, but the piezoelectricity is enhanced surprisingly with an increase in the Sc content r. Although bulk wave velocities decrease with r, they are still relatively large. These features seem very attractive for the use of wireless and batteryless SAW sensors as well as RF SAW filters operating in the 1-3 GHz range. It is shown theoretically that large V and lage K^2 are simultaneously achievable when the ScAlN film is combined with a base substrate with extremely high acoustic wave velocities such as diamond and SiC. For example. the second (Sezawa) mode on the ScAlN/6H-SiC structure exhibits relatively large K^2 of 5.26% when the ScAlN thickness is 0.58 wavelengths, where V is also large (6,310 m/s).

	SAW delay lines are fabricated on the ScAlN/6H-SiC and ScAlN/single-crystal diamond (SCD) structures. Measured SAW properties are simulated well theoretically, and it is also found that the SAW propagation loss is very small. This may be owed to the very high SAW velocity. Finally, one-port SAW resonators are fabricated on the structure, and it is shown how high performances are achievable in 1-3 GHz range by use of the structure. For example, the resonance quality factor of 520 is obtained at 3.63 GHz by a SAW resonator on the ScAlN/SCD structure.