

## Insertion Loss Improvement of a Two-Port Saw Resonator Based on AlN via Alloying with Transition Metals

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**Abstract :** This paper describes application of X-doped AlN (X=Sc, Cr and Y) to wideband surface acoustic wave (SAW) resonators in 200-300 MHz range. First, it is shown theoretically that Cr doped AlN thin film has the highest piezoelectric strain constant, accompanied by a lowest mechanical softening compared to Sc doped AlScN and Y doped AlN thin films for transition metals concentrations ranging from 0 to 25%. Next, the impact of transition metals (Sc, Cr and Y) concentration have been carried out for the first time, in terms of surface wave velocity, electrode reflectivity, transduction coefficient and distributed finger capacitance. Finally, the insertion loss of two-port SAW resonator based on AlXN (X=Sc, Cr and Y) deposited on sapphire substrate is obtained using P-matrix model, and it is shown that AlCrN-SAW resonator exhibit lower insertion loss compared to those based on AlScN and AlYN for metal concentrations of 25%. This finding may position Cr doped AlN as a prime piezoelectric material for low loss SAW resonators whose performance can be tuned via Cr composition.

**Keywords :** P-Matrix, SAW-delay line, interdigital transducer, nitride aluminum, metals transition

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