ScAlN/Si SAW devices for surface acoustic wave/spin wave coupling

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Lately, modern surface acoustic (SAW) devices have gained a lot of interest in the excitation and manipulation of spin waves (SW) via SAWs. A thin magnetic layer deposited between the two interdigital transducers (IDTs) of a SAW device can be used to achieve coupling of SAWs with SWs. The increase of the SAW resonance represents an important target in SAW/SW coupling applications as the SAW resonance should fit the ferromagnetic resonance for a better coupling efficiency. Up to now, most of the works that demonstrate the SAW/SW coupling have used lithium niobate as piezoelectric material for the SAW. This substrate limits the resonance frequency of the fundamental mode and higher order (and low amplitude) harmonics need to be used for SAW/SW coupling.

ScAlN is a novel material, still in research, with an enormous potential for acoustic devices fabrication due to its excellent piezoelectric properties, surpassing reported values for other group III-nitrides [1].

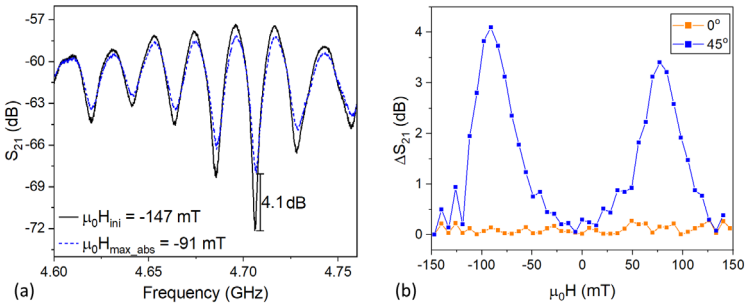

Figure 1: (a) S_{21} for a SAW structure on ScAlN/Si; (b) The absorption on the entire magnetic field range, when the probe is rotated at 0° and at 45°.

In this presentation we will review our latest results regarding the Sc(30% doped) AlN/Si SAW devices [2]. We will focus on the SAW/SW coupling using a two-port SAW device, with a thin Ni magnetic layer placed between the IDTs (digit/interdigit spacing width of 170 nm). The S_{21} parameter of the device was measured at two different angles between the SAW propagation and the magnetic field direction (Fig. 1): $\theta = 45°$ where the maximum absorption was observed and $\theta = 0°$, where there is no influence of the magnetic field on S_{21}.

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[1] F. Hadj-Larbi and R. Serhane, *Sensors and Actuators, A: Physical*, vol. 292. pp. 169–197, 2019.
[2] A. Nicoloiu et al., *2021 International Semiconductor Conference (CAS)*, 2021, pp. 67-70.