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Design of III-Nitride multi-layer structures for optical and surface acoustic wave interaction

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Research efforts into Surface Acoustic Waves (SAW) devices built on III-Nitrides has recently significantly intensified because of the increasing availability of good-quality epitaxial material. Owing to their strong piezoelectricity and high acoustic velocity, high-Al-content materials are of particular interest in high-speed applications (GHz electronics). For optoelectronics applications III-Nitrides cover a wide range of wavelengths from ultra-violet (AlN) to blue (GaN) to infra-red (InN); thus providing great flexibility in the choice of operating wavelength.

III-Nitrides, therefore, become particularly attractive for the development of acousto-optic modulators where the SAW is used to create a controllable (moving) optical grating, causing the diffraction of the Optical Guided Wave (OGW). The interaction is governed by the momentum and energy conservation and importantly by the field overlap of the two waves.

We present here design guidelines and modelling results for the development of III-Nitride-based multi-layer structures to support both OGW and SAW. The purpose of this study is to attempt to optimise the device efficiency compared to single GaN-layer structures typically used in the literature where only the SAW characteristics are optimised.