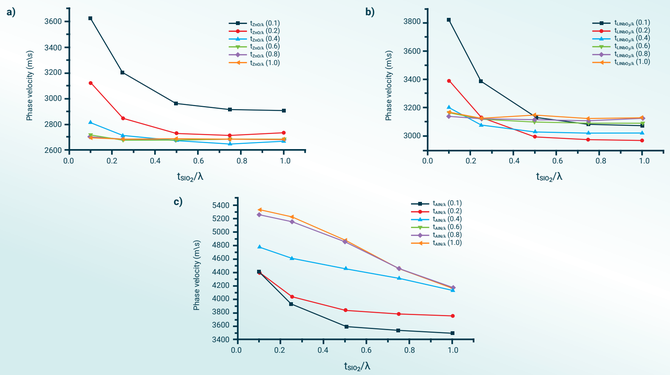
FEM ANALYSIS OF VARIOUS MULTILAYER STRUCTURES FOR CMOS COMPATIBLE WEARABLE ACOUSTO-OPTIC DEVICES

Wearable applications featuring photonic on-chip sensors are on the rise.

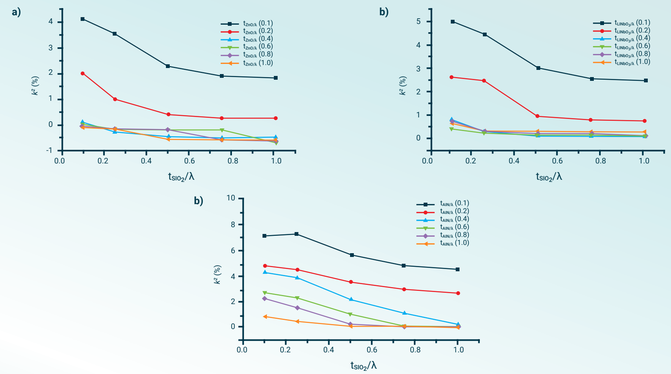
The acousto-optic technique is seen to be popular in modulation or control of optic signals in optic devices.

Study of different multilayer structures is carried out to fabricate an efficient acusto-optic device with high figure of merit.

FINDINGS:



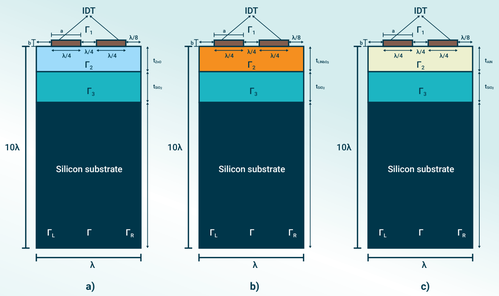
Phase velocity versus normalised thickness of SiO_2 on different normalised thicknesses of (a) ZnO (b) $LiNbO_3$ (c) AlN.



Electromechanical coupling coefficient (k^2) versus normalised thickness of SiO_2 on different normalised thicknesses of (a) ZnO (b) $LiNbO_3$ (c) AlN.

CONCLUSIONS:

It is found that the AlN/SiO_2/Si multilayer structure gave the highest k^2,i.e., 7.15 at the normalised thickness of 0.1λ (for SiO_2 and AlN layer). It also has the highest acousto-optic figure of merit, i.e., 7.04×10^{-14} s^3/kg (which is also higher than the AOFM of individual bulk materials used in this study). Hence, it is concluded that by using an AlN/SiO_2/Si multilayer structure, a high acousto-optic figure of merit can be achieved, which is not possible by using any choice of single bulk material. Moreover, it makes it possible to realise lab-on-chip applications using AlN/SiO_2/Si structure, which is a CMOS compatible SAW structure.



A two-dimensional unit cell geometry used in FEM simulation for the multilayer structure (a) (ZnO/SiO_2/Si), (b) ($LiNbO_3$/SiO_2/Si) and (c) (AlN/SiO_2/Si).

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