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POS-21 - The determination of GaAs phononic crystal waveguide SAW mode frequencies

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Two-dimensional void inclusion phononic crystal waveguide structures on gallium arsenide (GaAs) can be used to control surface acoustic waves (SAWs). In GaAs, SAWs create a piezoelectric field, providing a dynamic spatial confinement potential of electron/holes, which can then be implemented to transport charge and potentially spin. This work develops the first phononic crystal technology in GaAs with the goal of developing an acoustic charge transport method via phononic crystal waveguide modes. The use of single and double linear defect phononic crystal waveguides is studied both numerically and experimentally. Finite element analysis device simulations are performed in COMSOL to provide the propagation characteristics of SAWs in phononic crystal waveguides. Simulations are conducted for three-dimensional domains, which have an improved accuracy over previous two-dimensional studies. For the experiments, devices are constructed using optical photolithography with the phononic crystals produced using reactive ion etching and the interdigitated transducers (IDTs) fabricated through the lift-off of evaporated aluminum. To experimentally determine the SAW mode frequency, wideband phase modulated SAW transducers are placed in front of the waveguide. The wide bandwidth of the transducers allow for scanning the precise mode frequency. By having the waveguide mode frequency determined, a tuned transducer with focusing capability is placed in front of the waveguide to excite the waveguide mode. The mode resonates sufficiently to generate a moving potential which has the possibility to be utilized for future charge transport studies.

Primary author: Mr MUZAR, Edward (Queen's University)

Co-author: Dr STOTZ, James (Queen's University)

Presenter: Mr MUZAR, Edward (Queen's University)

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