# Developing SiGe on Sapphire Technology


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## Background/Relevance

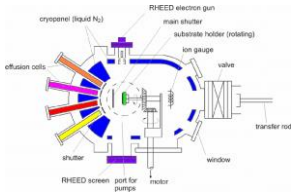
- Using sapphire substrate will reduce the parasitic capacitance hence better frequency response and less power loss.
- Incorporating Sn on Ge and SiGe induces direct band gap which helps in fabricating photodetectors that are more sensitive to infra-red due to radiative recombination.

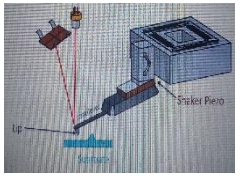
## Innovation

- Growing SiGeSn and GeSn material on sapphire that can be used to make photodetector of its kind.
- The photodetector made, having low parasitic capacitance as a result of using sapphire substrate.

## Approach

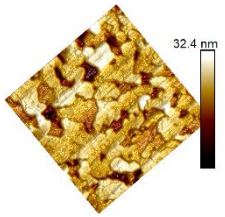
- Epitaxial growth of GeSn, SiGe and SiGeSn films on $Al_2O_3$ substrates using MBE with Ge/Si buffers
- Characterize the samples – AFM, XRD, PL, TEM and Ellipsometry

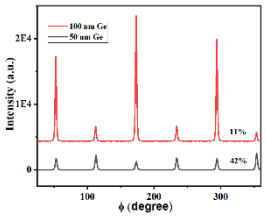


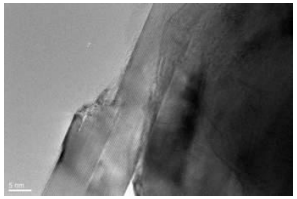




## Key Results

- Achieving a smooth surface morphology and improving the crystal quality
- Reduction of crystal defects
- Materials with direct bandgap with increased optical responsivity



## Conclusions

- Sapphire as a dielectric helps in reduction of the parasitic capacitance.
- Direct bandgap GeSn/ SiGeSn good for fabricating photodetector.
- Increasing Sn content extends spectral response to longer wavelengths without sacrifice in material quality or responsivity.

## Future Work

- Continual investigating of the best growth parameters for GeSn/ SiGeSn growth on sapphire is needful.
- Investigate the amount of Sn in Ge and SiGe that that results to direct bandgap to give a good optical responsivity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