Compositionally graded InGaN/GaN heterostructures: A new approach to explore phonon-plasmon coupling as a means to minimize heat back flow

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Research Question - Exploring lattice phonon and surface plasmon coupling in compositionally graded InGaN/GaN heterostructures grown by Metalorganic Chemical Vapor deposition (MOCVD)

Why or how is this interesting, novel, or unique?
The growth of the compositionally graded films is to be achieved by MOCVD and this is rather unique since combinatorial material science capability has generally not been done using CVD*.

***One known report of combinatorial MOCVD that involves a complex injector head and flow channel geometry**

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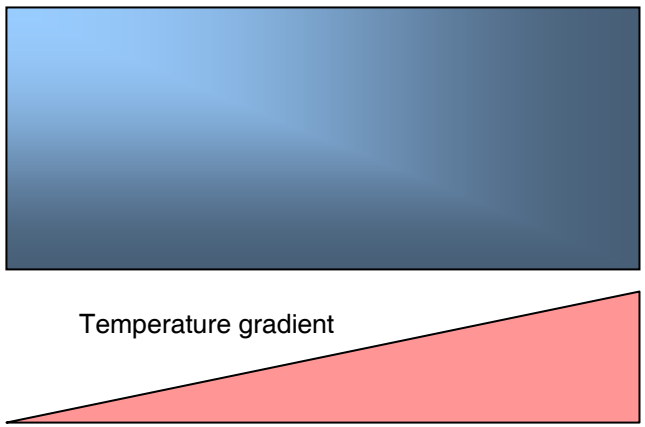
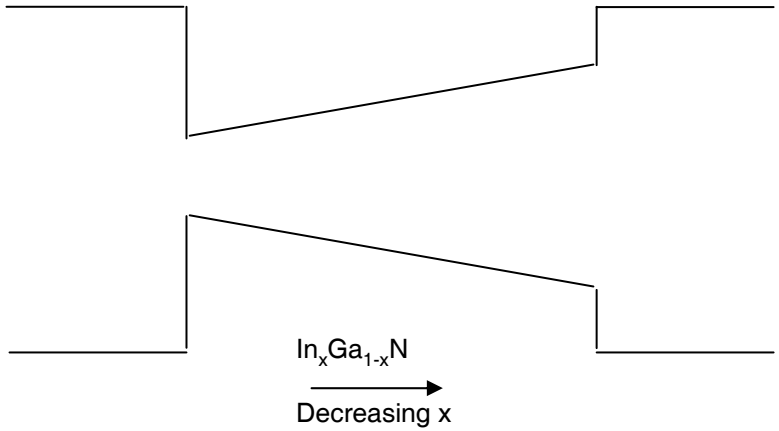
Research Approach: The approach centers on developing a temperature gradient over the substrate during film growth thereby controlling the amount of heavy element incorporation into the film.



Composition of InGaN as a function of temperature gradient



Band gap as a function of Composition (internal fields omitted for illustration)

- Modification of the reactor head manifold and susceptor arm to create a temperature gradient.

- Film growth with desired Indium content following the modification.

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- Currently working on the modifications to create the temperature gradient.

- Compositionally graded films grown will be characterized for film quality, epitaxy and indium content by X-ray diffraction, Photoluminescence, Rutherford backscattering.

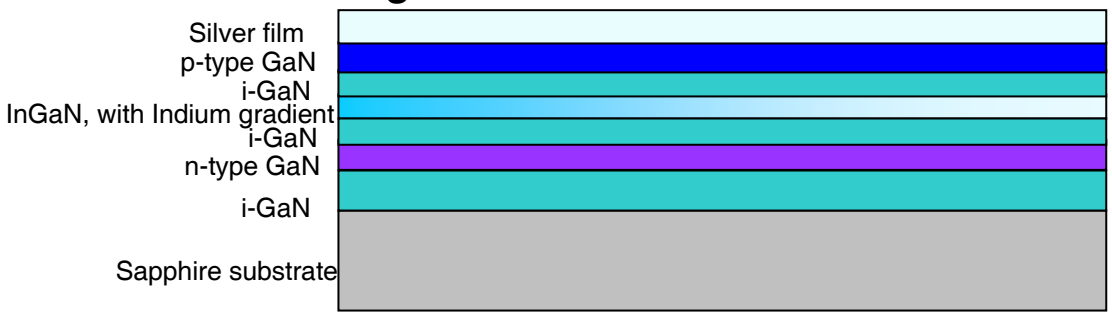

Illustration of the proposed thin film heterostructure

- Following this, patterned silver film will be deposited to investigate phonon-plasmon coupling.

- The successful coupling would in effect depopulate phonons by coupling them with the surface plasmon of a noble metal film, which is lost radiatively due to the surface roughness in the films.

- The findings will have applications in reducing efficiency losses due to heat back flow in most semiconductor devices.