

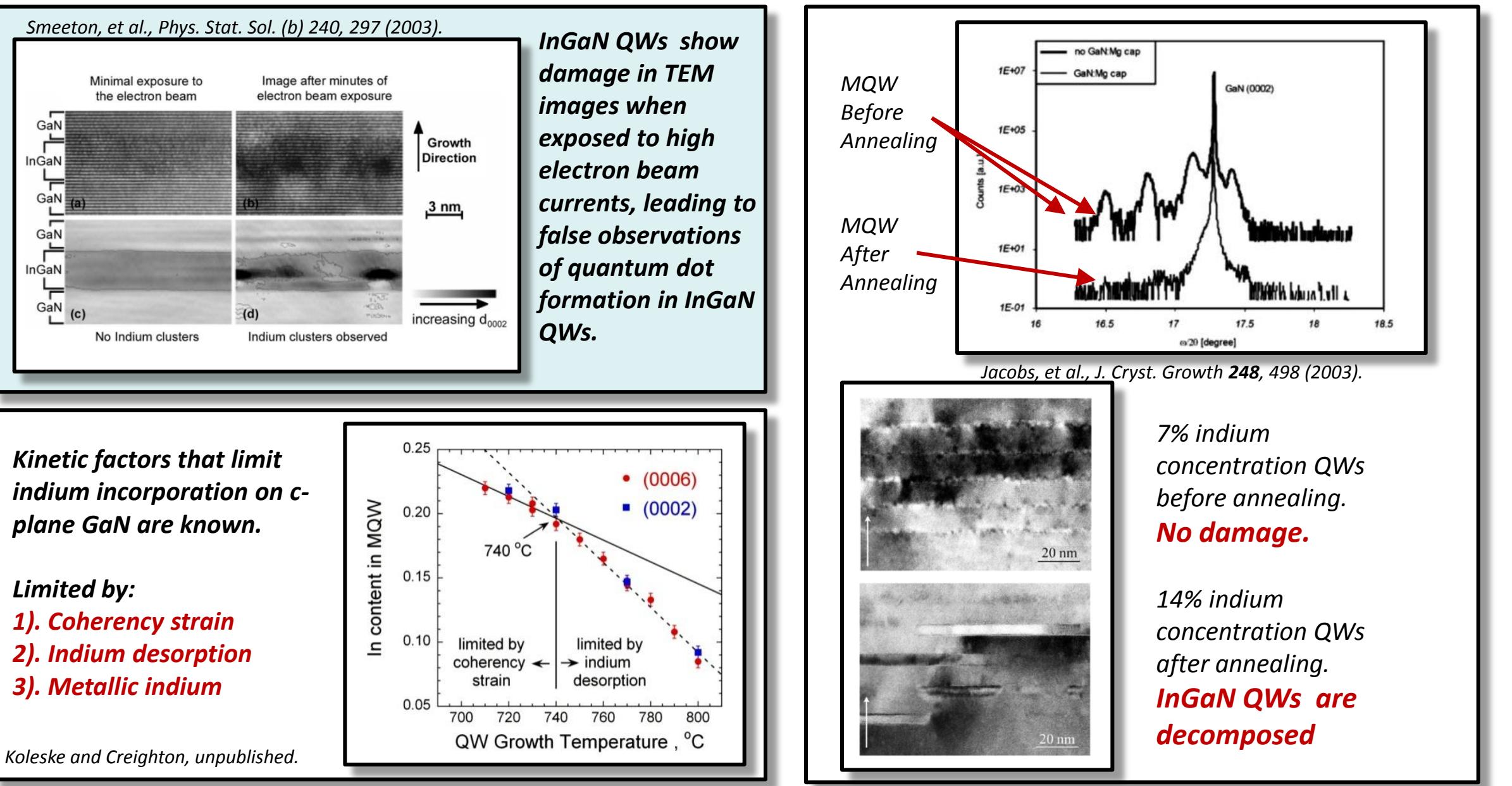
# Thermal Stability of Thin InGaN Films

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## Motivation and Background for InGaN Decomposition Studies

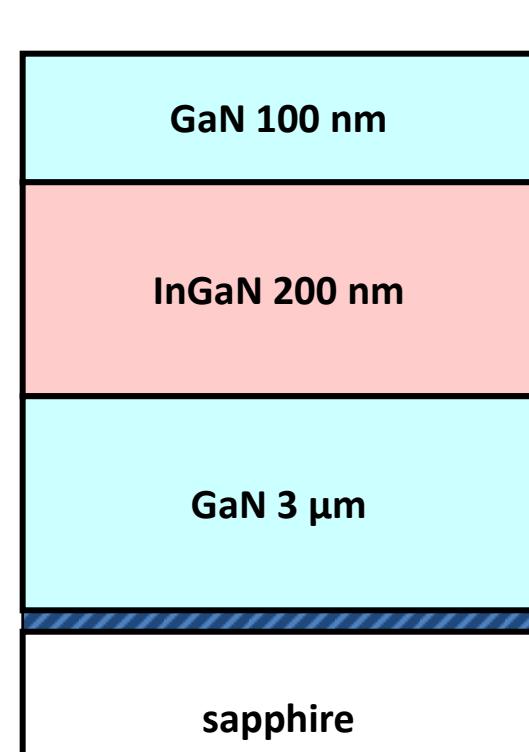
**Motivation:** Since InGaN quantum wells (QWs) are grown at lower temperatures and the surrounding GaN barrier layers are grown at higher temperatures, there is concern that the InGaN QWs may undergo some degree of decomposition during the growth process.

**Background:** There has been little work on this topic. InGaN decomposition has been studied primarily by TEM and XRD with little optical characterization. InGaN was found to decompose to indium and gallium metal.



## Thermal Stability of Thin InGaN films on GaN

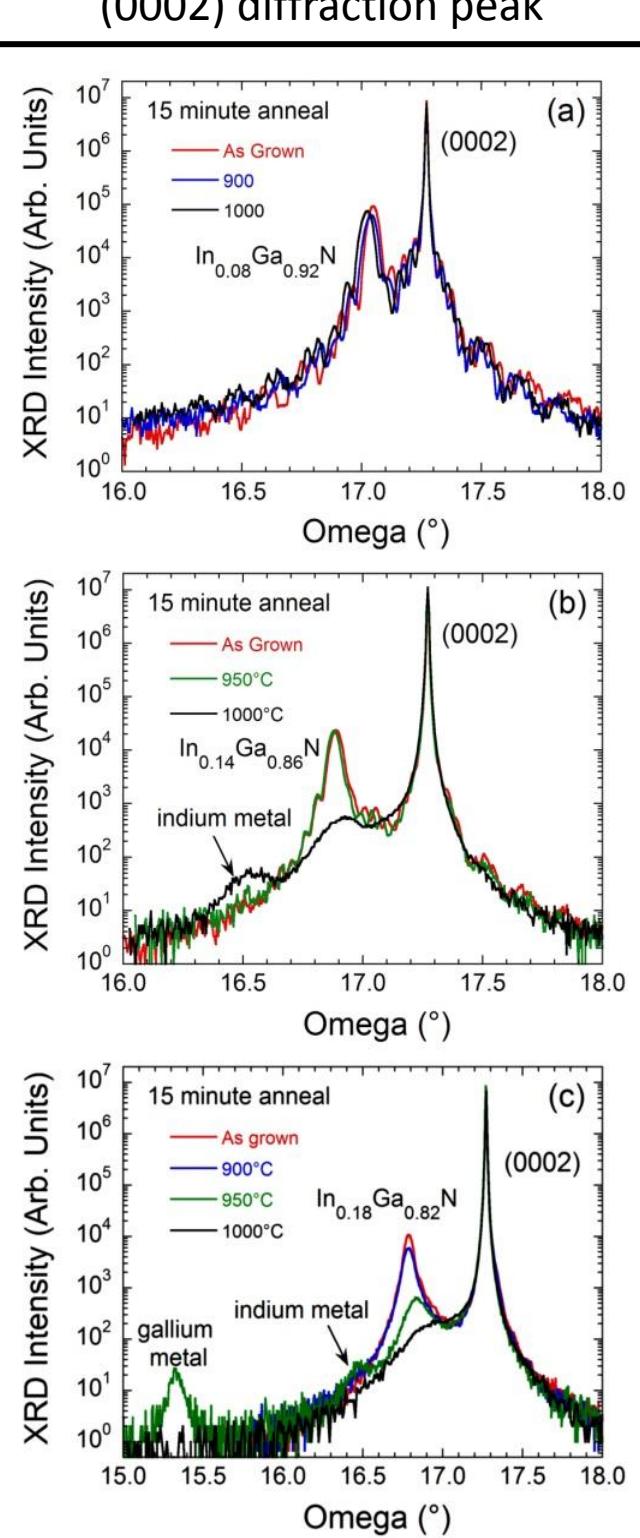
### Sample structure



### InGaN annealing conditions

1. Use 1/4 wafer
2. Anneal in N<sub>2</sub>
3. Anneal at a single temperature from 600 to 1000 °C
4. For times ranging from 15 to 60 min.

### XRD $\omega/2\theta$ scans of the (0002) diffraction peak

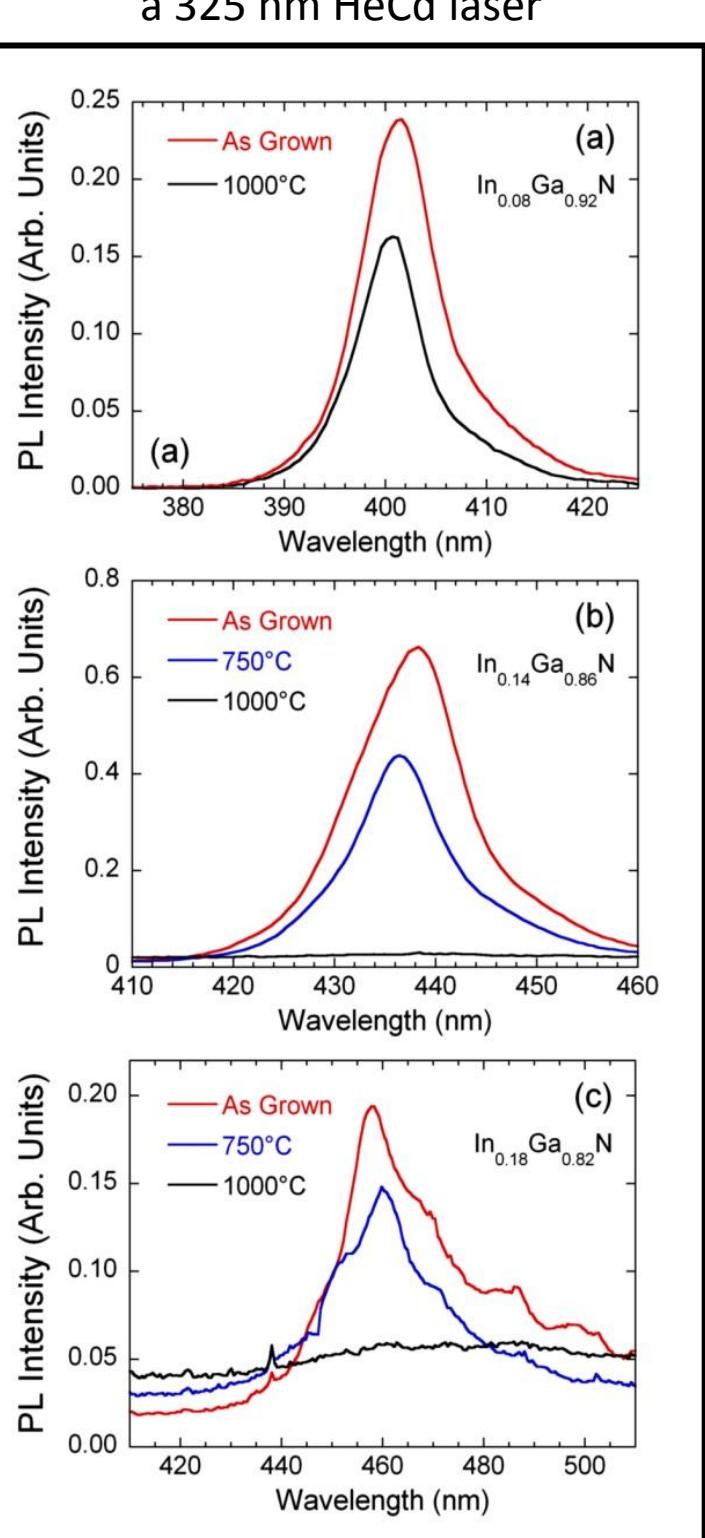


3% InGaN very little decomposition

14% InGaN increased decomposition

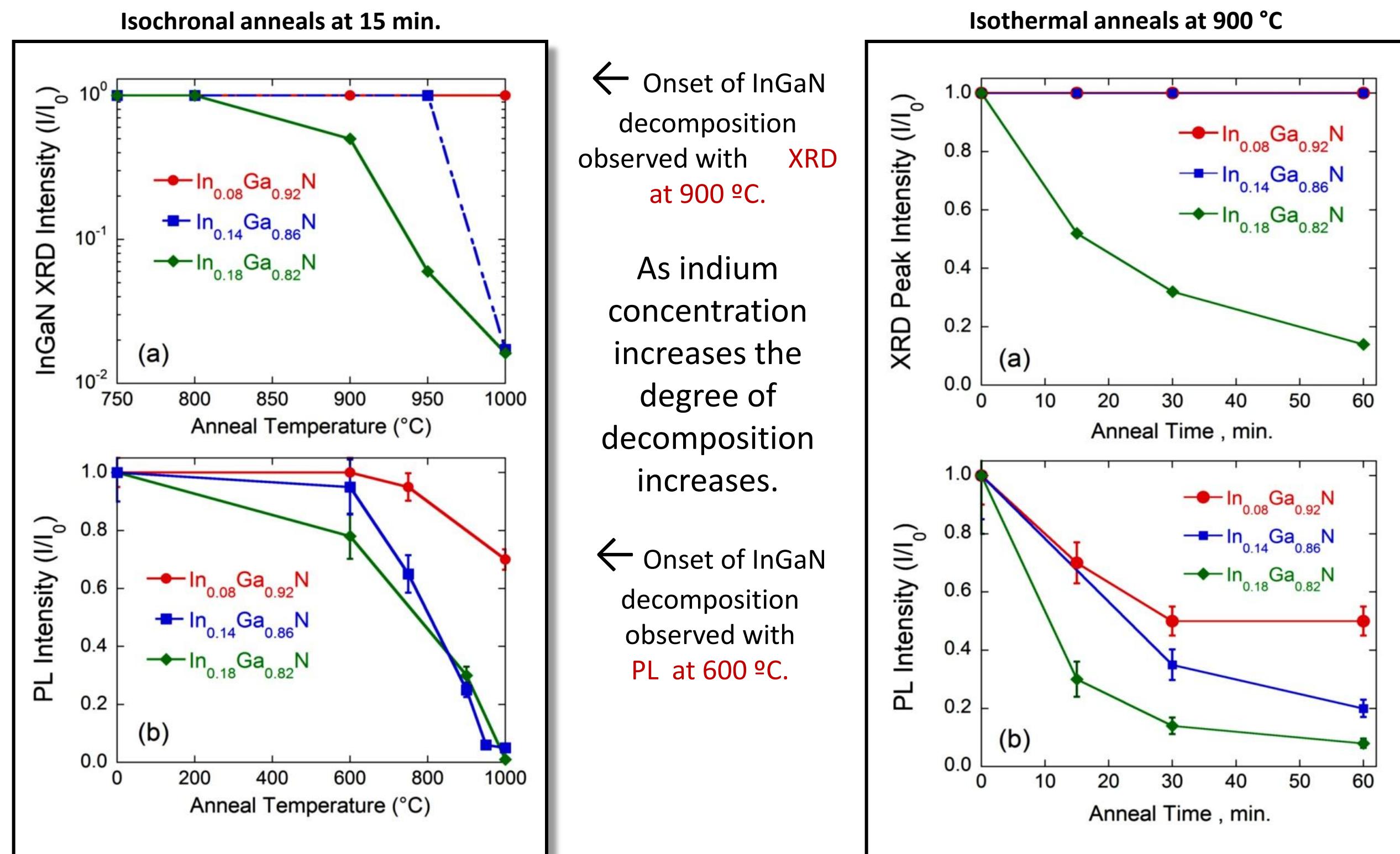
18% InGaN extensive decomposition

### PL intensity measured using a 325 nm HeCd laser



In XRD scans, observe metallic indium and gallium

## Summary of measured XRD and PL intensities for annealing studies

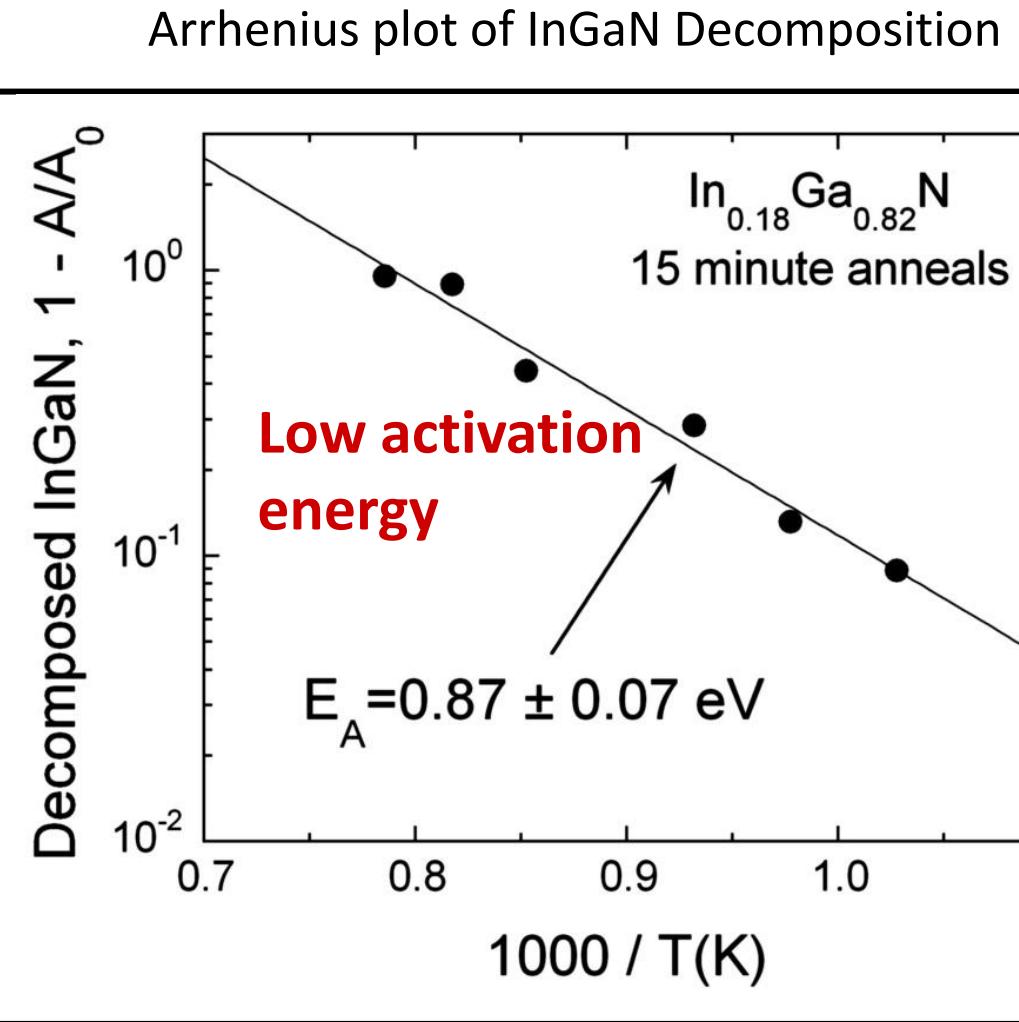


Onset of InGaN decomposition first observed by PL followed by XRD

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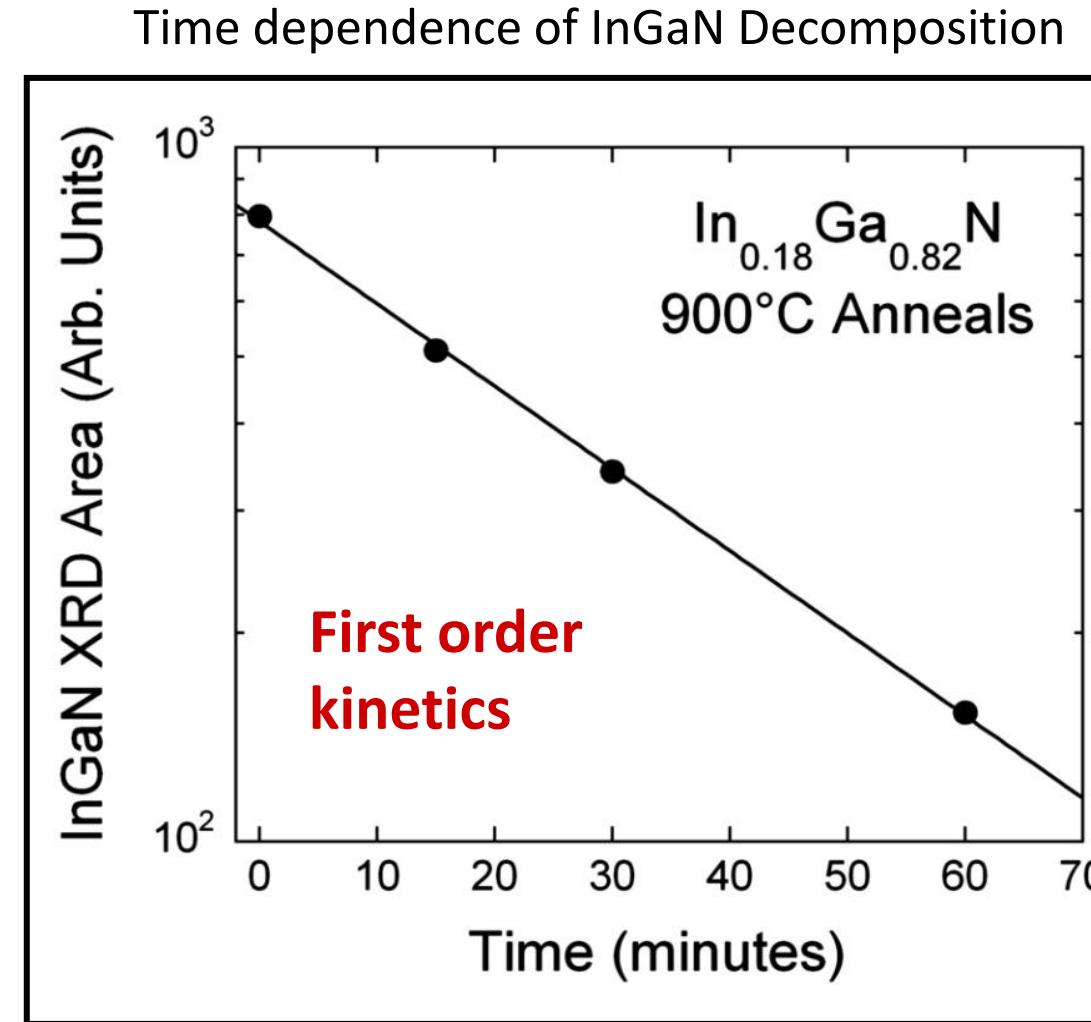
## InGaN Decomposition Kinetics and Summary



Low activation energy suggests simple In-N bond cleavage as the rate limiting step.

### Summary:

1. Higher indium concentration InGaN decomposes at lower temperatures than previously thought.
2. PL intensity decreases first observed at 600 °C, possible increase in non-radiative defects.
3. Later stages of InGaN decomposition observed in XRD.  $2\text{InGaN} \rightarrow 2\text{In(m)} + 2\text{Ga(m)} + \text{N}_2$ .



First order kinetics  
Pseudo-first order kinetics also suggests a simple In-N bond cleavage.

