Design and construction of a high-pressure CDV system with integrated real-time optical diagnostics for the growth of InN and related materials

http://www.phy-astr.gsu.edu/dietzrg/HPCVD.html

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Stabilization of InN under blanket of high pressure molecular nitrogen will enable processing at higher temperatures $T$ than attainable at atmospheric and sub-atmospheric pressure.

$p = 100$ atm $\quad T = 900$K

Potential gains of high $T$:
- Improved nucleation kinetics
- Improved surface morphology
- Improved microstructure at growth temperature
- Improved match to optimum GaN processing temperature

However, in HP-CVD a pronounced influence of flow-kinetics and gravity is expected!
Development of an improved HPCVD reactor: Design considerations

Design Criteria

- Maintenance of laminar gas flow (constant cross section)
- Symmetric substrates arrangements
- Access to Real Time monitoring
Development of an improved HPCVD reactor: Implementation

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Real-Time Optical Characterization of Flow Dynamic and Growth Kinetics during High-Pressure CVD

Cross Section of high-pressure Reactor with integrated optical access ports

Top & Bottom Parts of Split Insert

Photograph of the square flow channel in the middle section of the reactor
Development of an improved HPCVD flow channel reactor to study the growth kinetics in real-time

- reactor
  - pressures up to 100 bar
  - optical access to growth chamber

- gas delivery
  - compress precursors
  - alternate injection of precursors
High-pressure CVD system: Temporal Control of Precursor Compression and Injection

Temporal Control of Precursor Injection

Pressure

NH₃

Time

N₂

NH₃

Bypass

Precursor Compression

NH₄Valve Settings

Compress Inject

Fill Reservoir

Drain Reservoir

TIM Valve Settings

Fill Reservoir Compress Inject Fill Reservoir Compress

Drain Reservoir

High-pressure N₂

Reactor


