

# Growth of InGaN/GaN core-shell structures by molecular beam epitaxy

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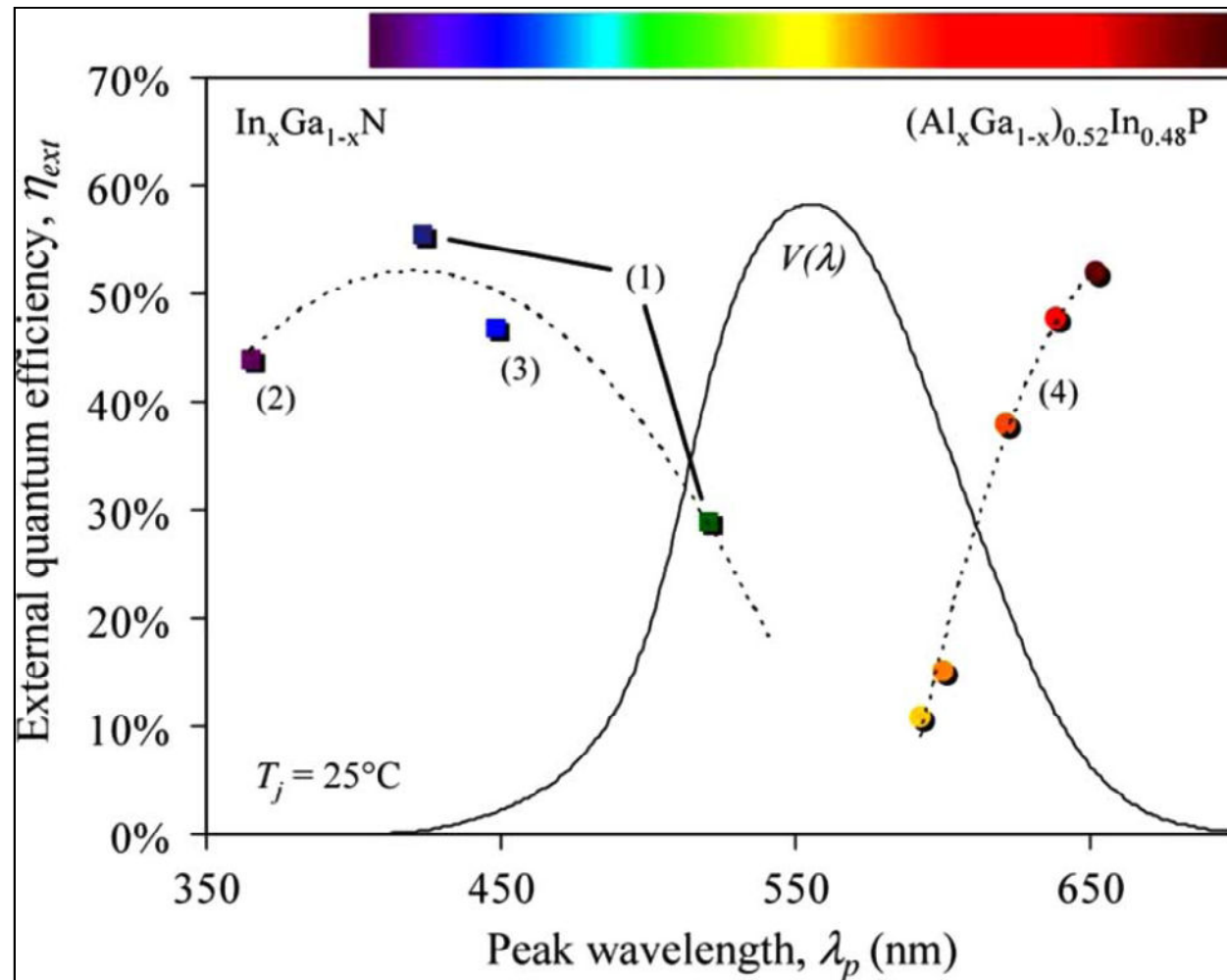
26.05.2015



slide 1



# Introduction (1)



Efficiency drop in the green–yellow region in planar InGaN structures associated with:

- high defect density
- high spontaneous and piezoelectric polarization

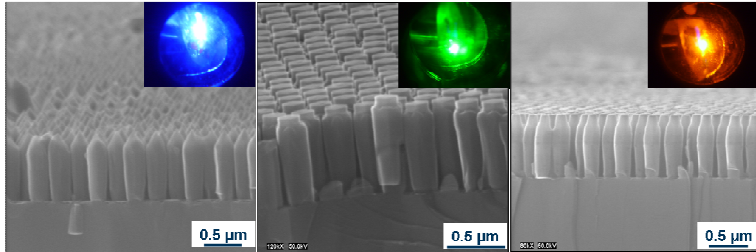
→ solution:  
**SAG NANOCOLUMNS (NCs):**

**superior over self-assembled NCs in terms of homogeneity and colour control**

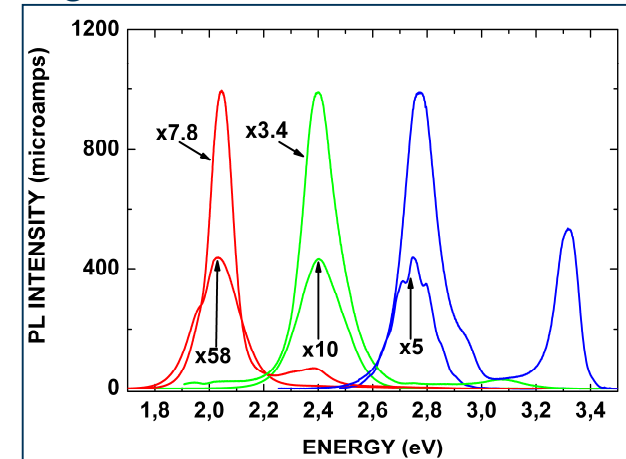
*M. H. Crawford IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, 15, 4, 2009*

# Introduction (2)

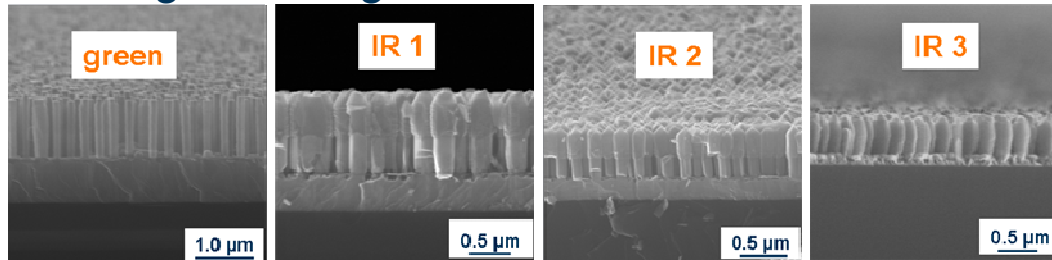
- selective area growth of InGaN/GaN NCs allows for single color emission on **GaN/sapphire templates**



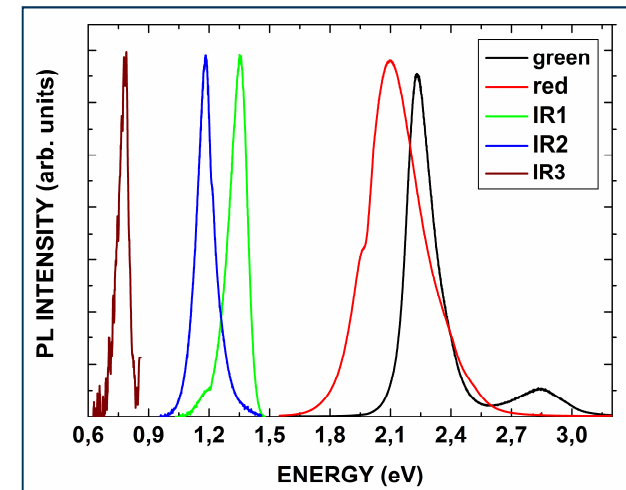
S. Albert, A. Bengoechea-Encabo et al., *J. Appl. Phys.* 113, 114306 (2013);  
S. Albert et al., *Appl. Phys. Lett.* 102, 181103 (2013)



- SAG InGaN/GaN NCs with an In content of up to 100 % were grown on **Si(111)** → PL-IQE up to 30% in the green range

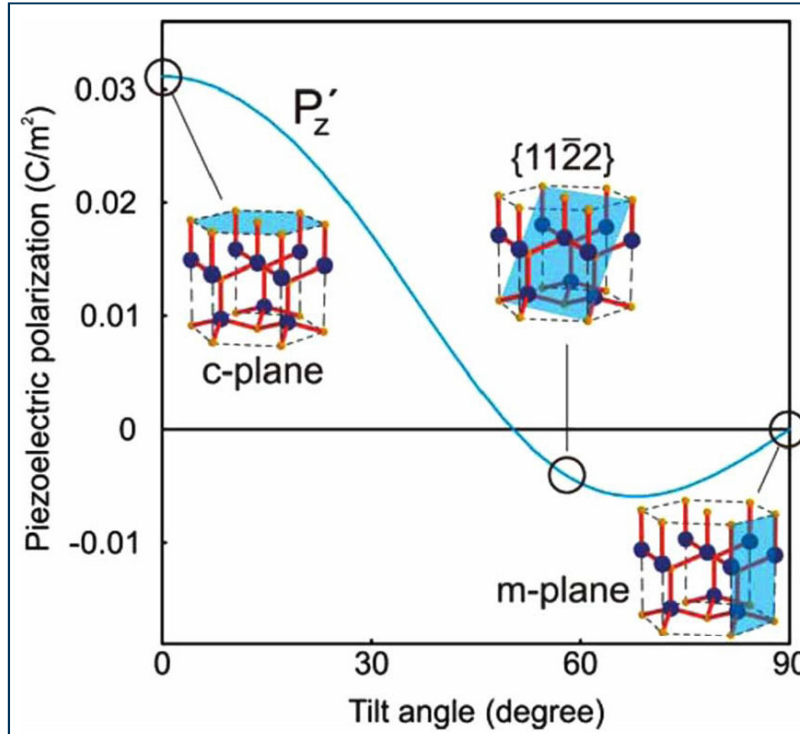


- still polarization effect due to growth on c-plane  
**solution: growth along semi-polar or non-polar direction**



S. Albert, A. Bengoechea-Encabo et al., *Nanotechnology* 24, 175303 (2013)

# Introduction (3)



- further improvement expected when growing active region on semi-polar or non-polar facets
- ↓
- reduces the polarization effects in wurtzite materials
- problem: high defect density in affordable non- and semipolar substrates

*M. H. Crawford IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, 15, 4, 2009*

Solution:

1. Free standing non-polar HVPE substrates → **very expensive** ☹️
2. Growth of active material on semipolar facets of GaN NCs grown along the c-direction
3. Find new ways to get high quality substrates → coalescence of a-plane NCs with very high quality
4. Growth on non-polar m-plane sidewalls of GaN NCs