High Efficiency LEDs using Cubic GaN

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Gallium Nitride (GaN) Based LEDs

- GaN based LEDs are driving a revolution in the way we generate and use light
  - Low cost
  - Energy Efficient
  - Tuneable
  - Infrared to Ultraviolet

Source: Status of the LED Industry report, August 2012, Yole Développement
The “Green Gap”

- LED efficiency falls off very quickly as the emitted light is shifted towards green wavelengths.

- The “Green Gap” is a big challenge for tuneable RGB lighting and displays.

After MR Krames et al J. Display Technology 3(2) (2007)
GaN Crystal Structure

• Conventional LEDs are made from hexagonal GaN

• The “Green-Gap” could be overcome if LEDs could be made from cubic-GaN

• However the cubic phase of GaN is Metastable!
Stabilising Cubic-GaN using Cubic-SiC on Si

- Anvil Semiconductors are developing Cubic-SiC on Si wafers for SiC Power Transistors

- Anvil have for the first time produced 150mm wafers compatible with commercial production

- These wafers have a crystal structure which matches cubic-GaN and therefore stabilises the cubic phase
Cubic-InGaN Quantum- Wells

• Using Anvil’s SiC on Si substrates UoC have been able to grow cubic GaN structures which give strong light emission in the green.
Cubic GaN on 150mm Substrates

• UoC have for the first time grown single phase cubic GaN over 150mm diameter wafers

World First
Processing at Plessey Semiconductors

- Cubic GaN wafers have been processed on the LED manufacturing line at Plessey
- Demonstrates for the first time that cubic GaN technology is compatible with volume production
Next Steps

• A new project will start 1\textsuperscript{st} Feb 2017

• Project objectives:
  • Build on existing world leading achievements
  • Demonstrate full LED structures based on Cubic GaN on SiC on Si
  • Demonstrate a manufacturable process for cubic-GaN LEDs