Forward Looking Statement

• This presentation contains information about management’s future expectations, plans and prospects of our business that constitute forward-looking statements for purposes of the safe harbor provisions under The Private Securities Litigation Reform Act of 1995.

• Please see final slide for additional information regarding these statements.
Agenda

• GT Advanced Technologies at a glance

• LED manufacturing roundtable conclusions

• Sapphire substrates
  – Growth overview
  – Substrate fabrication
  – Materials studies
  – Market trends

• Next generation substrates – Soraa ammonothermal GaN

• Summary
GT Advanced Technologies

Diversified crystallization technology leader serving multiple growing industries

ASF™ Sapphire growth equipment
Sapphire substrate materials

Solar

LED

Power Electronics

Industrial

Polysilicon equipment
PV ingot growth equipment
HiCz® materials

Sapphire materials

Silicon Carbide (SiC) system
Dual-Focus Sapphire Strategy in LED Market

**GT Products**

Sapphire Crystal Growth Furnaces

**Equipment Supplier:** GT sells sapphire crystal growth furnaces (ASF™) to sapphire manufacturers

**Materials Substrate Developer:** Working with leading companies in LED value chain to develop sapphire solutions to market demands then share these market opportunities with our equipment customers. Salem is operationally an R&D facility first.

**Downstream LED Operations**

- Sawing/Lapping/Polishing/Packaging
- MOCVD
- LED Fab/Die Dicing
- Finished LED

Boule Growth → Core Fabrication → Epi-Ready Wafer Fabrication → Epi Wafer Fabrication → LED Chip Fabrication → Assembly

GT ASF™
LED Manufacturing Roundtable Substrates Summary

• There is a need for **larger substrates** which would drive the need for larger scale equipment and reduced raw materials costs

• **Improved quality and consistency** of products is required along with standard specifications

• Bulk growth processes need to be **better understood and controlled**

• There is a need for improved substrate fabrication processes

• There are opportunities for wafer **standards** to drive efficiency and consistency within the industry; such standards would greatly **clarify raw material requirements** and help determine which substrate manufacturing processes are best, leading to **cost reductions**

• Substrate manufacturing could become a new priority task, however, improvement to substrate manufacturing **will have a small impact on overall cost reductions** for LED manufacturing
  – Caveat 1: Sapphire material and substrate can have a downstream effect on yield
  – Caveat 2: Soraa’s GaN substrates are viewed as enabling a whole new class of devices with the intent of decreased $/klm
Sapphire Growth Methods

- First methods to grow sapphire developed around 1890, Verneuil Method.
  - Feed powder fed from top, crystal manually pulled to keep at correct distance from flame.

- Today over 60% of the world’s sapphire is still using this fundamental concept
  - Pulling/rotating the seed to create a crystal
  - Top-down growth
The Heat Exchanger Method (HEM) was created to provide improved repeatability, improved quality, and scalability.

HEM consists of a stationary process with the heat exchanger being used to drive the crystallization process.
Material Inspection and Allocation

**Boule Inspection**
- Boule
- High intensity light source
- Light table with polarized film
- Sapphire boule
- Maltese cross showing crystal structure of boule
- Polarized lens glasses

**Slab Inspection / Allocation**
- Slab
- High intensity light source
- Light table with polarized film
- Sapphire boule
- Maltese cross showing crystal structure of boule
- Polarized lens glasses

**Core Inspection / Qualification**
- LED Core
- Bubbles/Gas Inclusions
- High intensity light source
- Light table with polarized film
- Sapphire core
- Maltese cross showing crystal structure of boule
- Polarized lens glasses
General Core-to-Wafer Process Flow

- Sawing
- Ultrasound Cleaning
- Lapping
- Ultrasound Cleaning
- Edge Grinding
- Backside Marking
- Annealing
- Ultrasound Cleaning
- SSP/DSP (polishing)
- CMP Polishing
- Measurement Inspection
- Frontside Marking
- Final Clean
- Packaging
Sapphire “Metrics that Matter” Study

**INPUTS:** Measurable Fundamental Properties of Sapphire

- DIT (metrology of low angle grain boundaries, crystal structure, bubbles)
- Interferometry Transmission (200-800 nm)
- GDMS (elemental analysis)
- Color Analysis of Materials (color measurement)
- Laser Inspection and LED Surface Metrology (pre- and post-epi automated laser wafer inspection)
- X-Ray Diffraction (crystal micro-structure)
- Physical Properties

**PROCESS:** LED Process Variables and Macrosopic Interactions

<table>
<thead>
<tr>
<th>Sapphire Core</th>
<th>Finished Core</th>
<th>Epi-Ready Wafer</th>
<th>LED Wafer</th>
<th>LED Chip</th>
<th>LED Luminaria</th>
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<tr>
<td>(GT Advanced Technologies)</td>
<td>Wafering Study (3rd party)</td>
<td>MOCVD Study (3rd party)</td>
<td>LED Device Fab (3rd party)</td>
<td>LED Luminaria (3rd party)</td>
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<td>Crystal Growth (yields, process)</td>
<td>Wafering of Cores (process and performance)</td>
<td>Epitaxial Growth (process and performance)</td>
<td>LED Fabrication (process and performance)</td>
<td>LED Lamp (proof of concept)</td>
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<tr>
<td>Finishing of Cores (process)</td>
<td>Epi-Wafer Analysis (wafer yields, Ra, TTV, Bow Warp)</td>
<td>Photo Luminescence (LED light metrology, wavelength, color brightness)</td>
<td>Electrical Performance (forward voltage, reverse leakage, etc.)</td>
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<td>Wafer EPO Analysis (pits/cm²)</td>
<td>Leading LED Metrology Co. (post-epi automated laser wafer inspection)</td>
<td>LED Light Performance (peak wavelength, brightness, binning)</td>
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<tr>
<td>OUTPUTS:** Yields, Device Performance, Economics</td>
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<td>LED Material Yields [mm, quality, cost]</td>
<td>LED Wafer Yields and Quality (wafer yields, wafer geometrics, cost per wafer)</td>
<td>Epitaxial Yields and Performance (epitaxial efficiency, low defects, performance)</td>
<td>LED Device Yields (device color binning, brightness, electrical performance)</td>
<td>Luminarie (esthetics, performance, brightness, life)</td>
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Total of 25 cores, over 2,000 wafers, from 4 sapphire growth technologies were processed across the entire LED manufacturing process

Full results at [www.gtat.com](http://www.gtat.com)
“Metrics that Matter” Findings

- Material quality and growth impacts wafer yield and quality metrics

- Sapphire growth method impacts performance in epi and LED die fabrication

- Epi-wafer and HB-LED device yields were at, or above, baseline yields and only showed yield losses for material graded significantly below what GT grades in Salem as well as trains ASF customers as LED Grade

- Yield, yield, and yield…
LED sapphire material prices’ rate of decline has slowed – 2” and 4” dia sellers appear to be pricing at cash costs or lower

Note: $3.50 per mm is likely at or below cash costs for most sellers.

- 2” and 4” prices both down ~80% from peak
- 6” price down ~60% from peak

Source: GT management estimates.
Diameter Adoption Rates and PSS – Interconnected?

- Established tech leaders at 6” and not much PSS
- New entrants need to walk before they run – will stall the adoption of 6” diameter materials, while they master 2” and 4” yields

- PSS is a big deal
  - Not new, but surprising pace of adoption in past 6 months
  - Considered by many to be a must-have for new entrants to compete on brightness and yields of acceptable LEDs
  - The rise of PSS foundries and other specialists
  - Merger of CrystalWise and SAS based on PSS
  - New dynamics of PSS capabilities and IP (design, wafer patterning, MOCVD processes)

- PSS adoption likely to slow the overall adoption of 6”
  - PSS at 2” and 4” seen as priorities
Sapphire Materials Challenges Meeting Wafer Trends

- Process optimization across production process to maximize yield
  - Best done through collaboration between sapphire material producer and customers
  - Systematically define metrics that matter for process control, optimization, etc.

- Move to larger wafer diameters: 2” → 4” → 6” → 8”
  - For sapphire producer requires process and boule geometry optimization to locate larger cores in boule
  - Clarifying what matters will improve sapphire mfgs’ ability to manage costs as wafer sizes increase

- Standards are seen as a way to ease adoption of optimal material and wafer geometry
  - David Joyce co-chairing 6” wafer geometry task-force for SEMI
  - Luke Glinski co-chairing sapphire defects and measurement task-force for SEMI
Soraa Bulk GaN Development

- Virtually all semiconductor technology is based on native substrates
  - Si, GaAs, InP, SiC
  - Better performance, reliability, lifetime, cost

- Advantages for LEDs
  - Improved high-J performance & reliability
  - Simplified architecture, processing
  - Greatly reduced stress, bowing
  - Better MOCVD utilization
  - Nonpolar/Semipolar option

- Bulk GaN substrates available commercially, but:
  - Cost is high – vapor phase process (HVPE) with limited scalability, poor reactant utilization
  - Complex microstructure; defect concentrations too high for electronics
Soraa – Unique Approach, Progress

- **Ammonothermal GaN**
  - Analogue of quartz growth (~ 8000 tons/year, cheap!)
  - 2" diameter, ultralow-defect true bulk GaN crystals demonstrated by AMMONO
  - Significant technical progress by AFRL Hanscom, UCSB, others
  - Challenges:
    - Low growth rates (~ 0.3-4 µm/hr, depending on orientation)
    - High cost, limited scalability of superalloy-based autoclaves
    - Residual impurities
- **SCoRA™** – Scalable Compact Rapid Ammonothermal
  - Internally heated – avoids material property limitations
  - Access pressure > 5000 atm; temperature > 650 °C
  - Cheaper, more scalable than superalloy autoclaves
- **Results – Crystal Growth**
  - Growth of c-plane, m-plane, semipolar crystals 5 mm – 2" diameter, 0.5 – 3 mm thick
  - Growth rates > 10 µm/hr
  - Crystalline quality ~ HVPE routine, dislocation densities < 10⁴ cm⁻² demonstrated
  - Epitaxial quantum well structures grown on SCoRA wafers
Summary

• Sapphire scaling to meet the demands of the industry
  – There are multiple sapphire growth methods – for LED material HEM, KY are dominant

• Understanding the impact of sapphire growth method and material assessment through the value chain can enable sapphire wafer mfgs to focus on the right metrics
  – SEMI standards can help to clarify focus on commercially optimal material

• Ammonothermal GaN is being developed by Soraa as a competing offering to enable lower defects and new GaN orientations
  – Emphasis is on more light output per unit area

• For more info:
  – www.gtat.com
  – www.soraa.com
Forward Looking Statements

This presentation contains information about GT Advanced Technologies Inc.’s management’s future expectations, plans and prospects of its business and industry/markets that constitute forward-looking statements for purposes of the safe harbor provisions under The Private Securities Litigation Reform Act of 1995. Such statements are identified by words or phrases such as “will,” “anticipate,” “estimate,” “expect,” “project,” “believe,” “target,” “guidance,” “forecast,” and other words and terms of similar meaning. In particular, forward-looking statements include, but are not limited to, statements regarding: Company serves several growing industries, Company targeting sapphire equipment and material sales for LED and non-LED end user (including industrial) markets; Company is building an industry with its ASF equipment product; use of LED in general illumination is expected to be more broadly adopted; adoption of six inch diameter sapphire materials is likely to be slower than expected; PSS will have momentum and as a shortcut to higher brightness and yields; process controls in sapphire manufacture are critical to profitable growth; expected that healthier and higher yielding industry may emerge that is capable of profitably serving the LED industry; PSS is considered a must-have for new entrants to compete on brightness and yields of acceptable LEDs; PSS adoption likely to slow the overall adoption of six inch wafers (two inch and four inch seen as priorities); China will produce and use a lot of sapphire and LEDs; Taiwan will have future wafer house expansions in China; expectation that yields drive profits and the sapphire choices drive yields; sapphire choices can affect wafer and LED profitability; the LED industry has strong growth potential; and that sapphire leaders must focus on driving higher yields of wafers and high-value LEDs to drive higher profits. These statements are based on management’s current expectations or beliefs. These forward-looking statements are not a guarantee of performance and are subject to a number of uncertainties and other factors, many of which are outside the Company’s control, which could cause actual events to differ materially from those expressed or implied by the statements. These factors may include the possibility that the Company is unable to recognize revenue on contracts in its order backlog. Although the Company’s backlog is based on signed purchase orders or other written contractual commitments in effect as of the end of its 2012 fiscal year, the company cannot guarantee that its bookings or order backlog will result in actual revenue in the originally anticipated period or at all, which could reduce the company’s revenue, profitability and liquidity. Other factors that may cause actual events to differ materially from those expressed or implied by the company’s forward-looking statements include the expected continued oversupply in the end markets for the output of Company equipment (which may decrease demand for the Company’s equipment offerings); the impact of general economic conditions and the tightening credit market having an adverse impact on demand for Company products, the possibility that changes in government incentives may reduce demand for solar products, which would, in turn, reduce demand for our equipment, technological changes could render existing products or technologies obsolete, the company may be unable to protect its intellectual property rights, competition from other manufacturers in all business segments may increase, exchange rate fluctuations and conditions in the credit markets and economy may reduce demand for the company’s products and various other risks as outlined in GT Advanced Technologies Inc.’s filings with the Securities and Exchange Commission, including the statements under the heading “Risk Factors” in the company’s annual report on Form 10-K for the fiscal year ended March 31, 2012 (filed on May 25, 2012). Statements in this presentation should be evaluated in light of these important factors. GT Advanced Technologies Inc. is under no obligation to, and expressly disclaims any such obligation to, update or alter its forward-looking statements, whether as a result of new information, future events, or otherwise.