OptoGaN

Enabling bulb-like brightness for LEDs

OptoGaN is a developer of product- and process technology
for white HB-LEDs for applications that request LEDs
with bulb-like brightness such as
Illumination, Automotive and LCD-Backlighting

Now

- Incorporated in 2004, OptoGaN operates

Research center in Helsinki, Finland:

- State-of-the-art cleanroom environment
- Research 3x2” MOCVD reactor
- Manual LED processing tools
- Set of characterization tools

Pilotline in Dortmund, Germany:

- State-of-the-art cleanroom environment
- Volume 19x2” MOCVD reactor
- Full chip processing line
- Analytical lab

LED Production Cycle

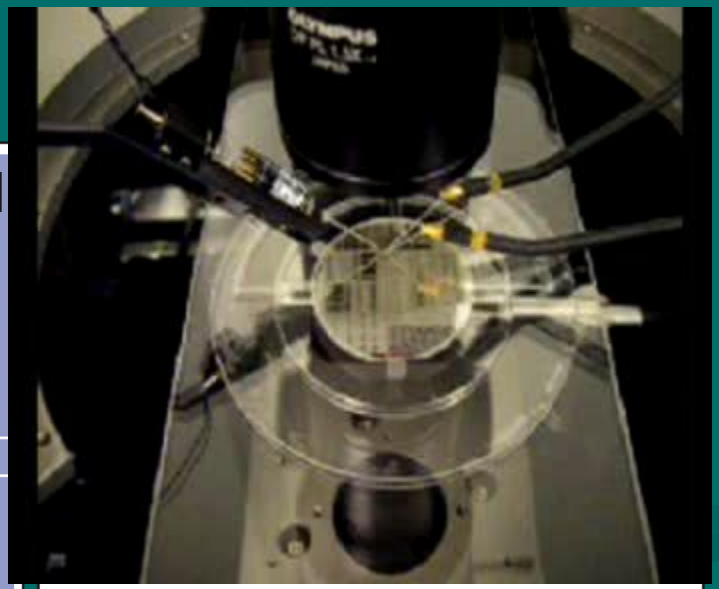
Производственный цикл

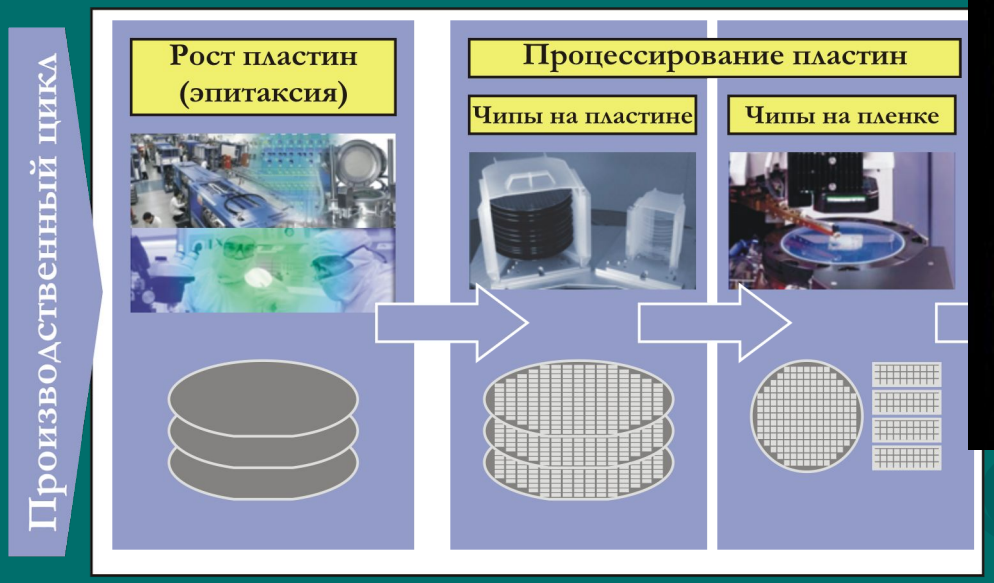
Рост пластин (эпитаксия)

Модель работы	Производство светодиодных чипов	Компания-партнер: производитель осветительных систем

LED Production Cycle

LED Production Cycle





Модель работы	Производство светодиодных чипов	Компания-партнер: производитель осветительных систем

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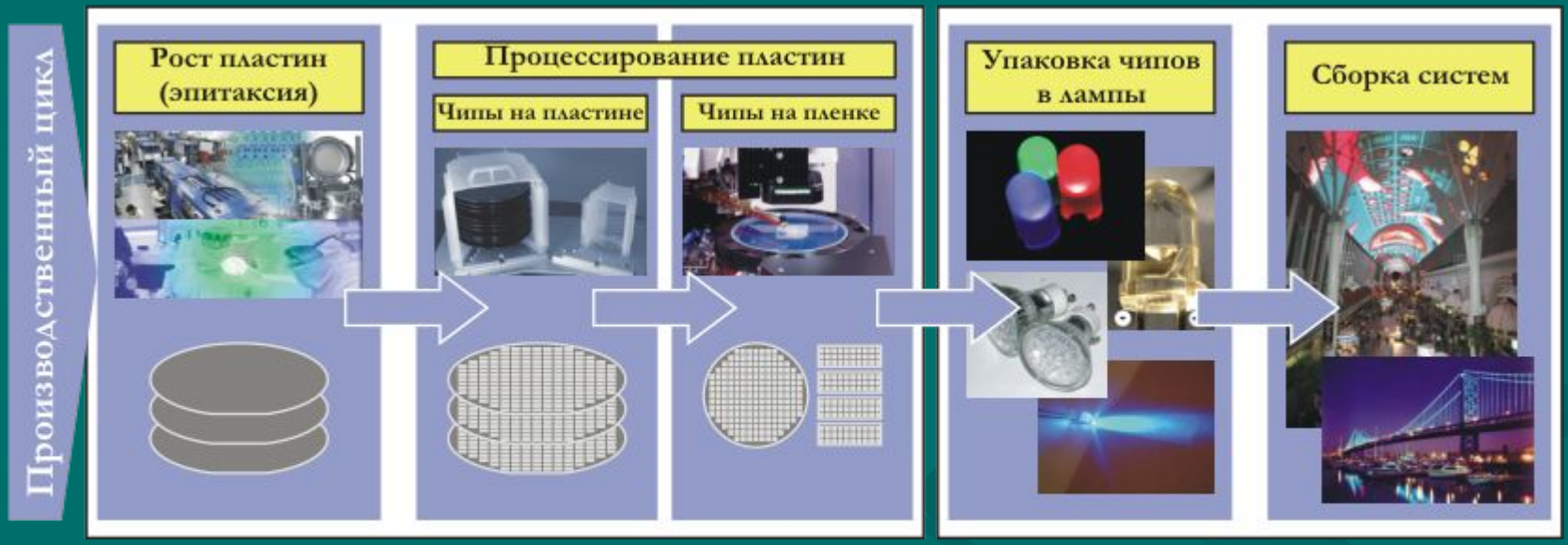
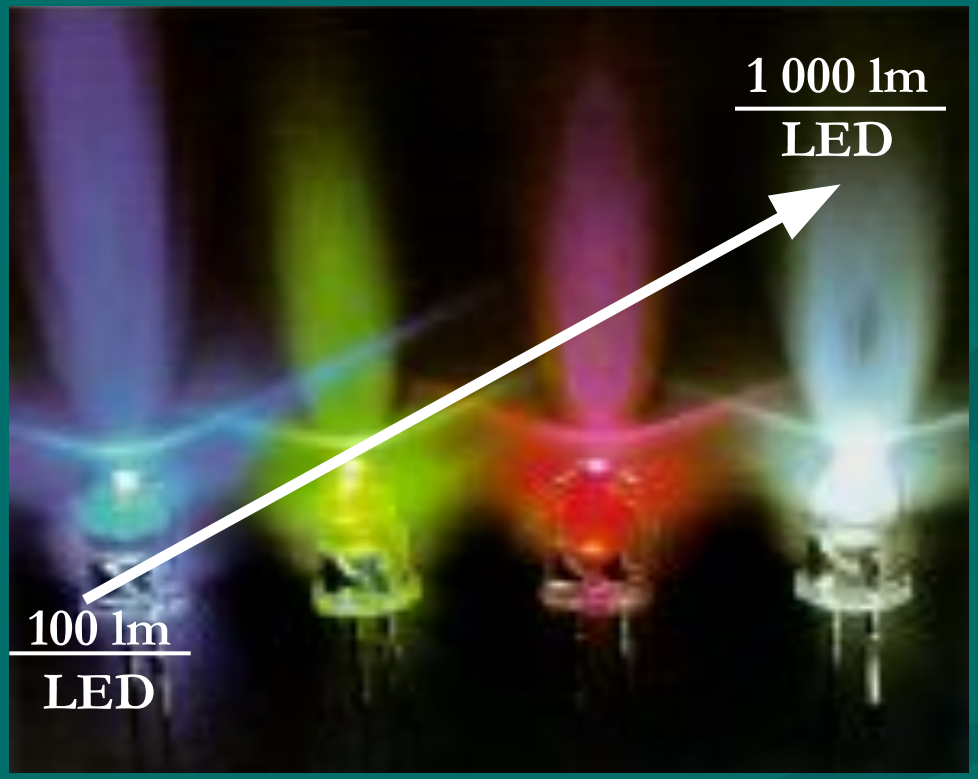
LED Production Cycle



Модель работы	Производство светодиодных чипов	Компания-партнер: производитель осветительных систем

Mission

$12 billion illumination market by **breakthrough in cost/performance ratio of LED lamps**



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Back lighting for cell phones and LCD:

Progress and growth in the cell phone LED market have improved as the displays have changed from green to yellow and blue and to full colour.

Use of colour screens is expected to grow to 75% by 2007.

Historical colour backlight market shares (in millions of cell phone units) :

- 28/400 in 2000
- the market share estimated to be 430/600 in 2006.

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Interior and exterior automotive lighting:

The LED advantages are:

- improved safety
- power savings
- styling opportunities
- reduced dimensions
- multicolour interior
- lighting options
- system cost savings

Annual market growth rates in this segment are expected to be in the 10 to 15% range.

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Large signs and displays:

- outdoor video signs
- sports stadia
- advertising
- mono-colour terminal
- traffic signals
- indoors for arenas and racetracks
- other video displays
- exit signs

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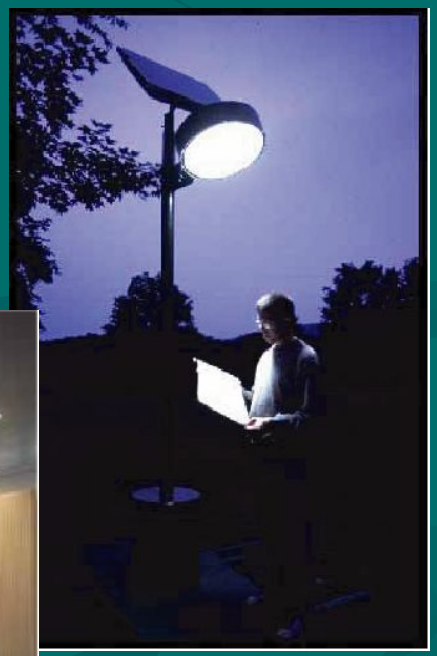
HB LEDs for Lighting:

Apart from these, GaN LEDs target the general illumination market worth of $12 billion.

The HB LEDs will compete with incandescent lamps by 2007 and majority of fluorescent lamps by 2012.

LEDs offer the wide range of advantages:

- *high efficiency,*
- *low power consumption*
- *lower operating temperatures*
- *the non-use of mercury*
- *extended lifetime (about 10 years)*
- *new design utilities*



Energy Savings:

Development of GaN technology is accepted as a strategic direction in many countries including USA, Canada, Japan, and Germany. One of the reasons is the potential advantages that can be derived from LED-based lighting from the point of energy saving.

In United States, the financial support for the Next Generation Lighting Initiative (NGLI) has been included in a Senate Energy Bill, and this technology was declared as vital for National Security interests.

The national project named "The Light for the 21st Century" has been also organized and funded by government in Japan.

Energy savings in USA due to penetration of HB LEDs in everyday life:

2002 – 9.6 TWh per year (1TWh = 1,000,000,000 kWh)

2015 - 970 TWh per year – equivalent to ~ 100 large power plants

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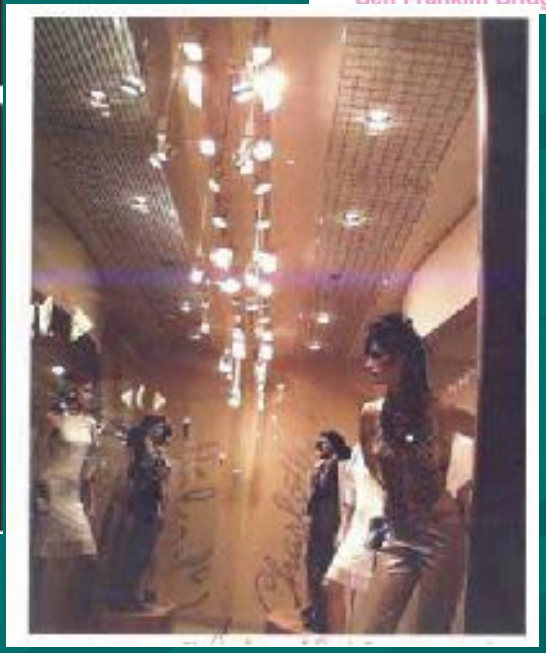
HB LEDs for Lighting:

Ben Franklin Bridge, Philadelphia, PA, USA



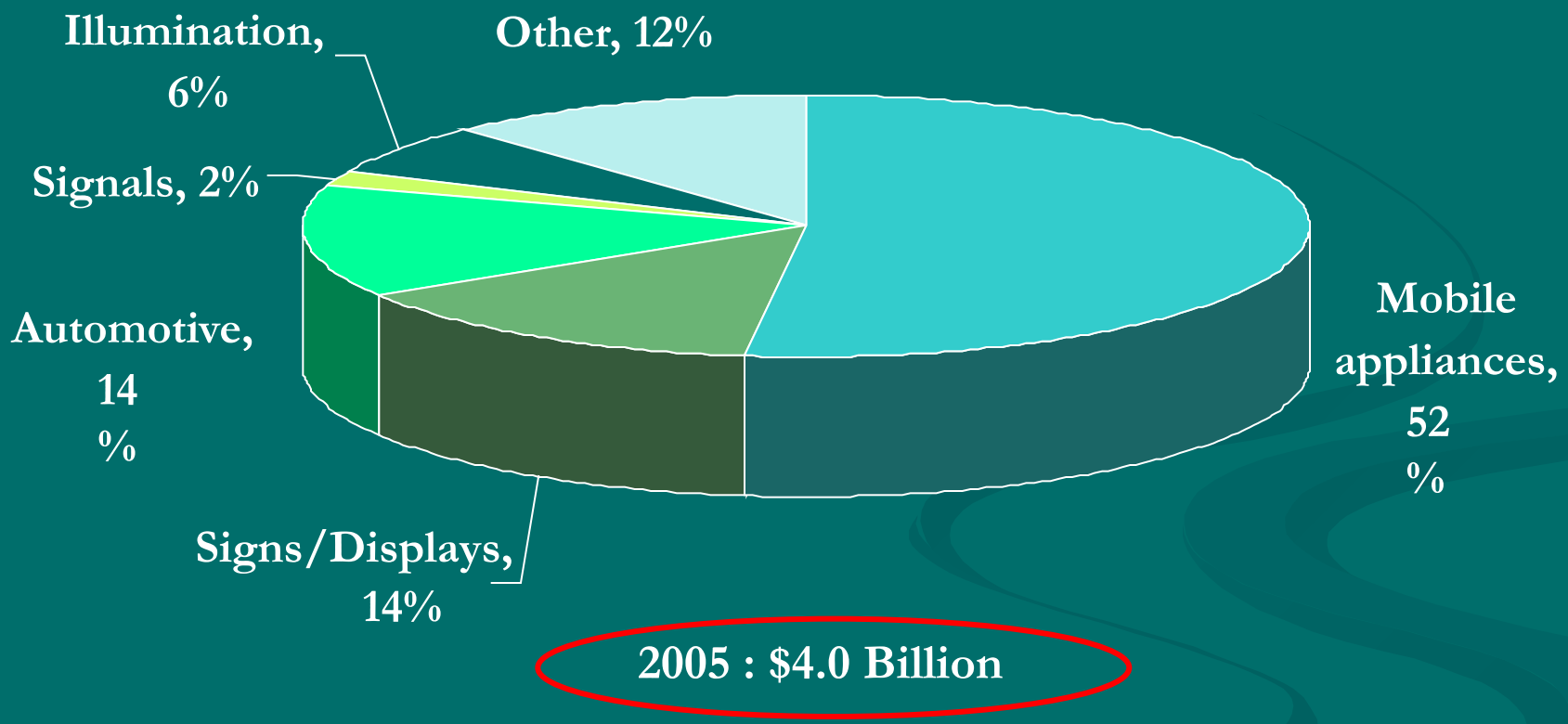
Emerging applications:

Upon developing, GaN technology targets also new high volume markets:

- Violet Lasers for next generation DVD high density data storage systems and high resolution printing/copying
- High power and low noise transistors for radars, cellular networks, satellite TV and communication, environment-monitoring systems;
- Ultraviolet Light Emitting Diodes and detectors for

• displays	• high-resolution optics	• UV air purifier
• UV lamps	• counterfeit detection	• photo-catalytic reactions
• spectro-fluorometry	• chemical detection	• medical applications

The LED market



LEDs: Established and rapid growing market

Figures after Strategies Unlimited

Next driving products

Market forecast: $8 billion by 2010

- Short-term driving product (2007-2008):

  1. Backlights for large LCD displays and LCD monitors
  - Technology target: at least 3-4 times less lumen cost (higher brightness and/or less cost)

  2. Auto headlamps: growth forecast 8% in 2006, compared to 3.7% in 2004
  - Technology target: Reliability (temperature, humidity) is of major importance

- Long-term driving products:

  Lighting will reach $1 billion in 2010
  - Technology target: ~ 10 times less lumen cost (higher brightness and/or less cost)

Figures after Strategies Unlimited

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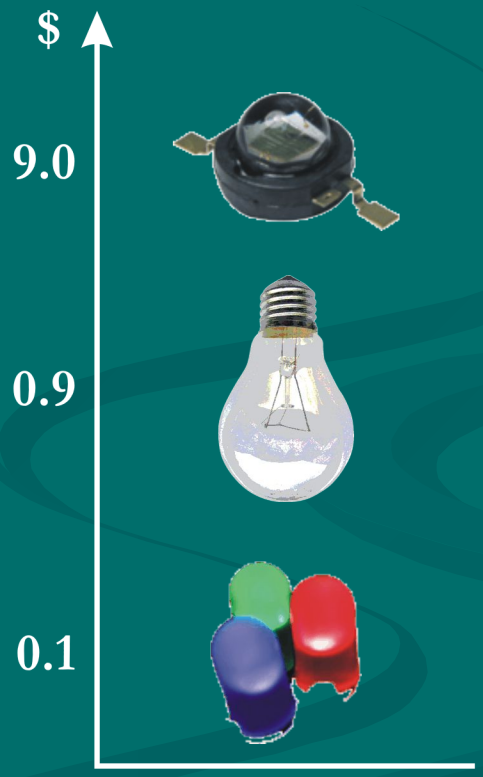
LED problems

Insufficient brightness

High street price



History

Founders:

Vladislav Bougrov

Maxim Odnoblyudov

1996: Graduated from St. Petersburg Electrical Engineering University (LETI)

Optoelectronics Department at A.F. Ioffe Physico-Technical Institute

1998: PhD in Physics from A.F.Ioffe Physico-Technical Institute

Working for Cree EED, TDI Inc.

1999: joint to European Research center (St. Petersburg and Bath (UK)) of Arima Optoelectronics Corporation (Taiwan)
Development of industrial technology for GaN LEDs.

Founding OptoGaN

Basis for OptoGaN: *understanding of the problems limiting LED performance and existing of ideas how to overcome them*

- OptoGaN was founded in 2004 as Finnish limited Company together with a group of Finnish entrepreneurs claiming specialization in fund raising for technology start-ups. Start up capital was 8,000 Euro.

Main problem for high-tech start-up: expensive facilities are required for technology proof (наличие дорогостоящего оборудования)

Main questions during fund raising with VCs (Критерии венчурных фондов):

- Team (Команда)
- Market (Рынок)
- Requirements for proof of technology (Подтверждение технологии)
- Requirements for IP protection (Патенты)
- Competitive advantage (Преимущества перед конкурентами)
- Customers (Потребители)

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Standard way to set up a company for researchers:

- to do development at University basis (разработка на базе университета)

"+": access to the facilities required, proof of basic technology, patents;
"-": sharing of IP rights with University (в Финляндии права принадлежат изобретателю);

- to get funding and rent facilities from service providers (аренда оборудования)

"+": fabrication of IP clean product prototype;
"-": very costly;

- to build own production line (собственное производство)

OptoGaN's approach

Approach taken by OptoGaN (utilization of Finnish innovation system):

- Established contact with Helsinki University of Technology, which has necessary facility (Установление контактов с Университетом Техн.)

- Joint application to Finnish Technology Agency (TEKES) to finance industrial oriented research (Получение финансирования совместного проекта от ТЕКЕС)
  - win-win situation: University gets substantial funding, Company access to facility (Университет получает финансирование, Компания – доступ к оборудованию)
  - proof of basic technology was achieved (ОптоГаН получил возможность начального экспериментального подтверждения базовых идей)

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Role of business angels

At early stage role of business angels is very important:

"-": risk is high, especially for VCs (большой риск)

"+": possibility to get substantial ownership at low valuation (возможность получить значительную долю в компании по низкой стоимости)

Professional assessment of technology potential and market value is extremely important (Чрезвычайно важна профессиональная оценка потенциала и реализуемости технологии, а также ее возможное место на рынке)

Seed Funding

OptoGaN was funded by VC with technologically skilled management (VNT Management). Investment was shared with TeSi (Finnish Industrial Technology Investment Fund) – governmental fund whose main task is to share risks with private investors. Company also received substantial grant from TEKES.

ОптоГаН получил финансирование от частного венчурного фонда, менеджмент которого имел значительный технический и индустриальный опыт. Со-инвесторам выступил Финский Индустриальный Технологический Фонд (TeSi) – государственная венчурная компания, задача которой разделять риски с частными инвесторами и содействовать развитию технологических компаний. Компания также получила значительный грант от ТЕКЕСа (40-50% общих затрат).