New Platform LED Technology

EVIYOS™

“Connected Digital Lighting”

Michael Godwin | January 2019 | DOE Workshop, Dallas

Light is OSRAM
Agenda

- OSRAM Opto Semiconductors at a Glance
- Evolution LED Chip & Packaging Advancements
- EVIYOS Products Details
  - Illumination &
  - Visualization
- Glare Free Matrix Light Headlamp Use-Cases
  - Adaptive Driving Beam
  - Pedestrian Messaging
  - Driver Assist
- General Lighting Context
- Summary
OSRAM Opto Semiconductors at a Glance

NAFTA
Sunnyvale | Novi/Exeter
- Headquarters NAFTA
- Sales and Marketing
- Application Centers, Novi MI
- Quantum Dot, Portland, OR
- VCSEL, Plymouth, MN
- Materials, Exeter, NH
- LED Preproduct Production

Europe | EEM
Regensburg
- Global Headquarters, R+D
- Chip Production
- OLED Production
- Sales and Marketing
- Application Centers

Asia | China
Hong Kong | Shanghai | Wuxi
- Headquarters Asia Pacific
- LED Assembly, R+D
- Sales and Marketing
- Application Centers

Asia | Japan
Yokohama
- Sales and Marketing
- Application Centers

Asia | Malaysia
Penang | Kulim
- SSL Headquarters
- Chip Production
- LED assembly R+D

OSRAM Opto Semiconductors at a Glance
OSRAM Opto Semiconductors Inc.
US Locations

Portland, OR – Branch Office
Focus on Quantum Dot R&D

Novi, MI - Branch Office
Focus on Sales, Marketing and Application Development

Sunnyvale, CA - Head Office
Focus on Sales, Marketing, R&D, HQ Activities

Exeter, NH, Platelet Material Mfg
Focus on Ceramic Platelet Materials

Material R&D in Cherry Hill, MA
Focus on Material R&D

Plymouth, MN – Vixar
Focus on VCSEL Technology
OSRAM Evolution in Products
Comparison to Silicon Industry

Through Hole          SMT          FlipChip & CSP          Integrated

LED

Time
Chip Design & Technologies
Full Portfolio for all Applications

Vertical (eg. or Thinfilm)

Vertical (eg. UX:3)

Lateral (Volume emitter)

- Lateral and vertical chip designs prevail in selected applications
- UX:3 favorable for performance applications → reduced current crowding, better $R_{th}$, high intensity

InGaAlP/ GaAs

InGaN / Sapphire
EVIYOS™ Platform Technology
Smart Hybrid Illumination & Visualization

**Addressable Micro Structured LED**

- High-resolution and active matrix array intelligent Si substrate
- Precise control of light without complex electronics.

![LED System on Chip](image)

LED Silicon

Novel joining technologies

LED System on Chip
EVIYOS™ Quadrants & Communication Block Diagram

- Individually addressable 1024 pixels (32 x 32 matrix) in 4mm x 4mm
- 115 um x 115 um cell and 125 um pitch
- 3 lm per pixels @ 11 mA, 3.5V, Ts = 25 °C
- 3000lm light source
- Two independent control units (one each 512 pixels)
- Four quadrant current adjustments (one each 256 pixels)
- Four high speed serial communication interfaces for pixel data transfer up to 50 MHz
- Two I²C slave interfaces for pixel configuration and diagnosis.
- Wide junction temperature range -40 °C to 150 °C
Motivation in Automotive Adaptive Driving Beam

State of the Art: EVIYOS™

Glare Free High Beam

- Sensing of oncoming vehicles & pedestrians w/ camera
- Dynamic masking
- Optimum illumination & visualization in various use cases

84 Pixel LED Array

EVIYOS: 4096 Pixel w/driver IC

- Sensing of oncoming vehicles & pedestrians w/ camera
- Dynamic masking
- Optimum illumination & visualization in various use cases

- 4X magnification
Forward Lighting Illumination Context

Complex Night Time Driving Situation (Illumination & Visualization)
Forward Lighting Illumination Context

Glare With High Beam On
Forward Lighting Illumination Context

The Low Beam Misses Many Important Details
Forward Lighting Illumination Context

LED Pixel-Rows for Multiple Glare-Free Areas
Forward Lighting Illumination Context

Small Pixels Allow Precise Control
Visualization of Traffic Signs on the Road

Yield

Stop
Visualization of Vehicle to X Communication

Navigation

Communicate with Pedestrians
Visualization of Road Assistants

Distance Assistant

Track Assistant
General Lighting Context
Hypothetical Situation Use Cases

Smart Lighting Use Cases

- Pathway lighting communication
- Shopping navigation aid
- Parking lot navigation aid
- Safety alerts
- City tourist navigation aid
- Hospital navigation aid
- Entertainment
- etc…
EVIYOS Delivers
Illumination and Visualization for Digital Mobility

Success Criteria

- **OSRAM** has advanced photonics and semiconductor technology into a new platform technology: **EVIYOS**

- Convergence of illumination and visualization into a monolithic scalable product: **EVIYOS**

- Integrated driver electronics enables simply dynamic control to creates adaptable driving beam use cases

- **EVIYOS** is a simple digitally controlled hybrid LED solution to realize forward lighting & new general lighting applications