LUMINUS

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LIGHT FOR LIVING | LIGHT FOR WORKING

# Luminus Summary


- Pioneer of photonic crystals for LED projection technology and high brightness vertical thin film LED
- Leadership in very-high-power density LEDs that enable exceptional focusing of light

# Luminus Summary

- Founded in 2002 based on technology developed at M.I.T. in Boston and innovations from Silicon Valley, we are a U.S. based manufacturer of advanced LED lighting solutions
- Headquartered in the USA with offices in Silicon Valley (USA) and Xiamen (China)
- Pioneer of photonic crystals for LED projection technology and high brightness vertical thin film LED
- Leadership in very-high-power density LEDs that enable exceptional focusing of light
- Wholly-owned private subsidiary of San'an Optoelectronics

# Luminus History



Boston Based Technology

- Leading high-intensity specialty LEDs
- Global presence & recognition
- High-reliability technology

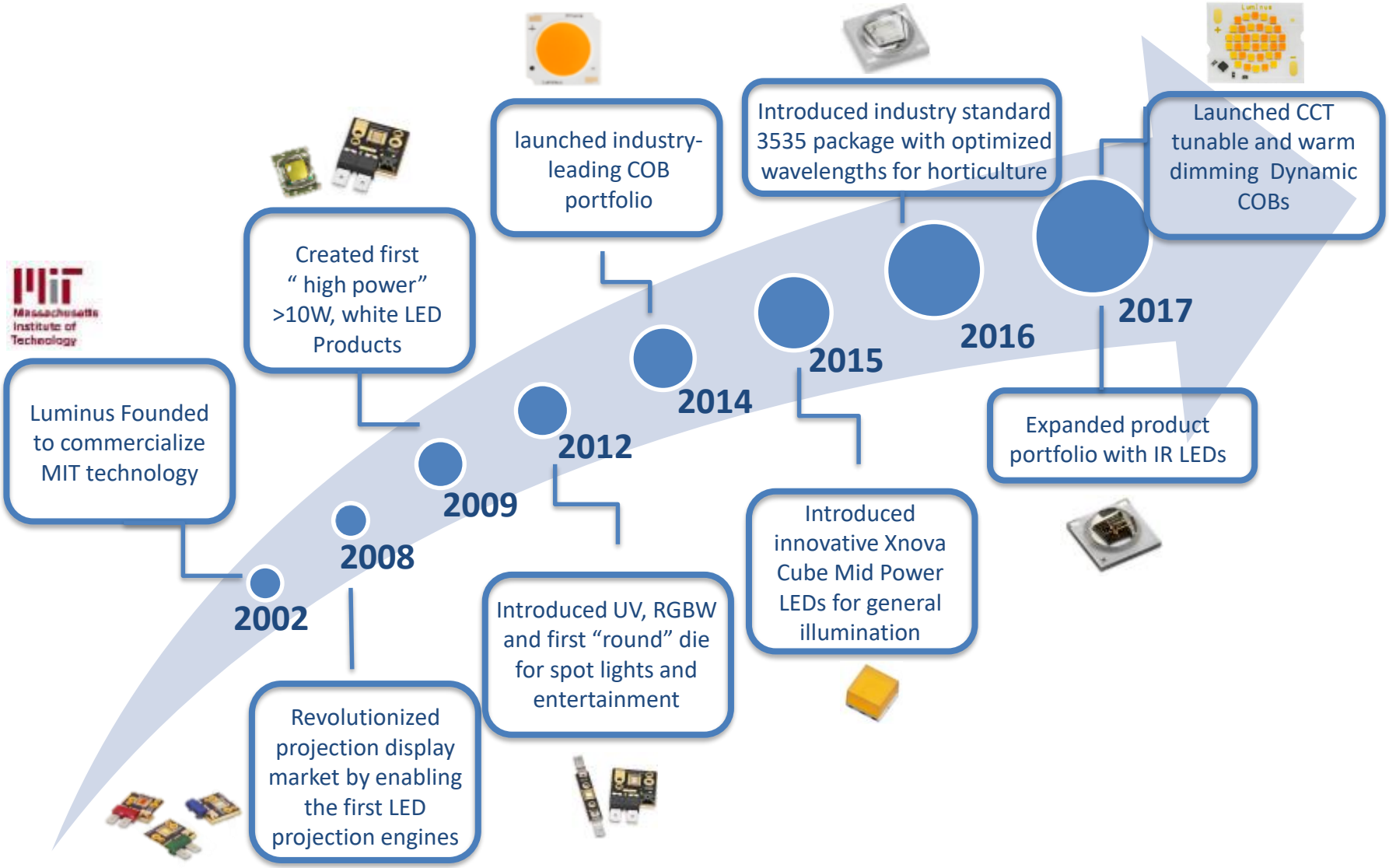
Silicon Valley Innovator

- Industry Leading Lighting LEDs
- State-of-the-art designs
- Strong Channels to Asia

## 2013 Merger Launched

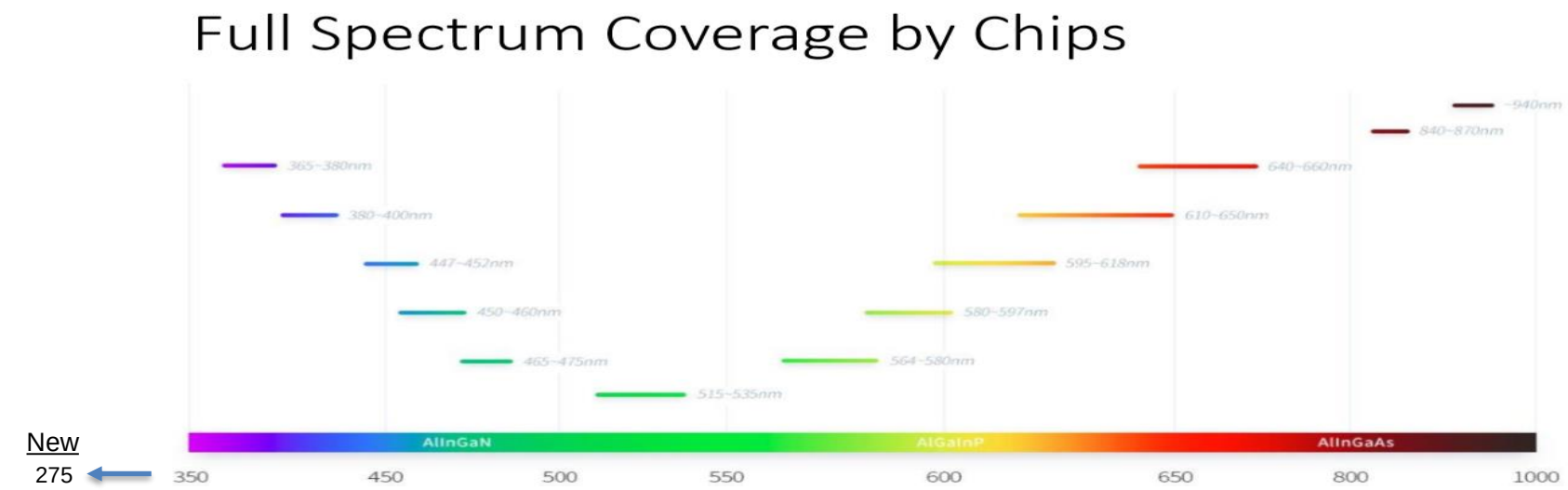
LUMINUS

# Luminus History & Milestones



# Luminus Core Competences

- **Broadest portfolio of product platforms and wavelengths**
- **Highest current density in the industry (5A/mm2)**
- **Brightest LEDs in the world**
- **Custom precision spectrums**
- **Highest Power packages in the industry with excellent reliability**



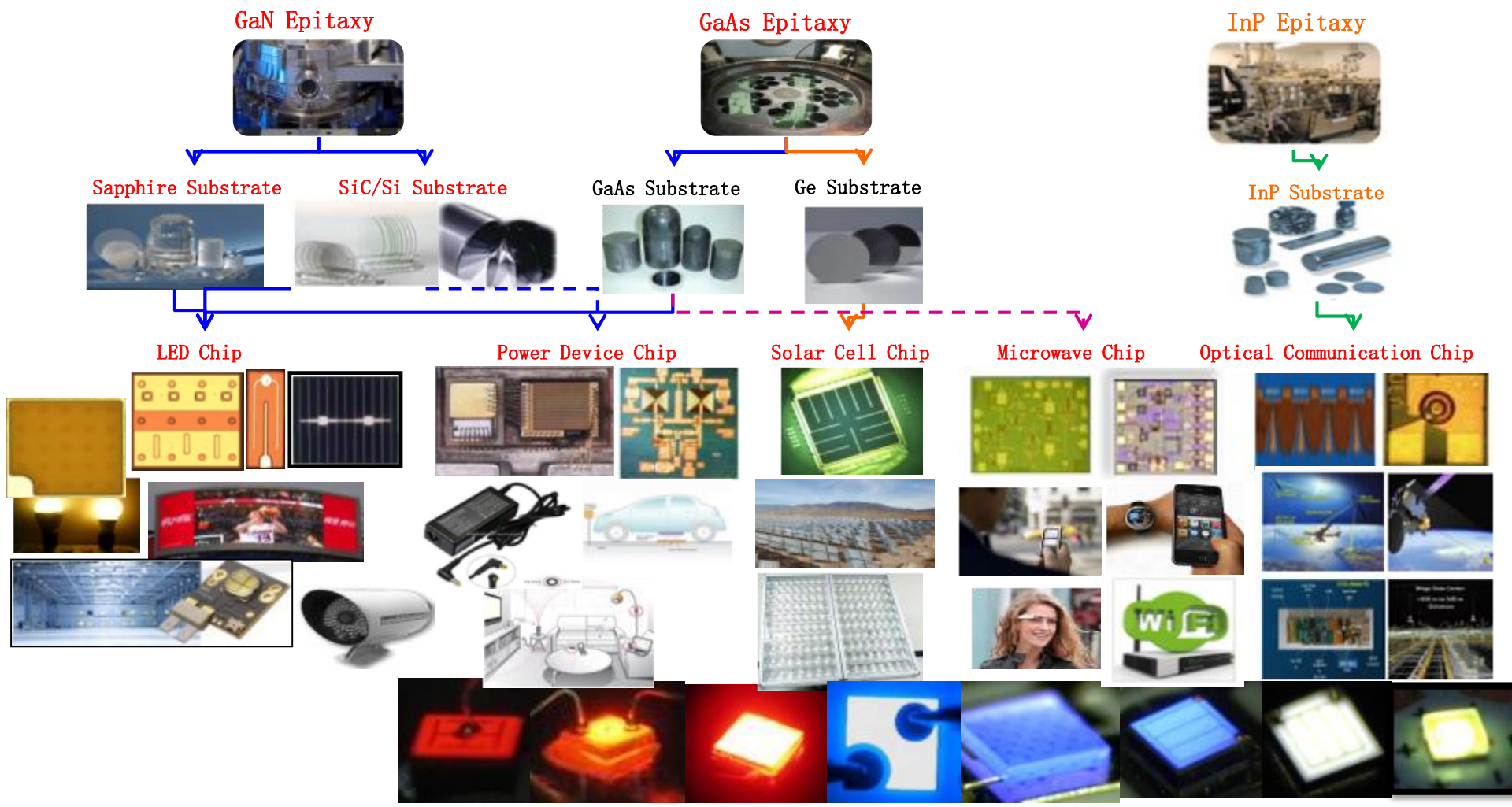
# GLOBAL PRESENCE

# Backed by San'an Optoelectronics

- **Established in 2000 with operations in Xiamen, Tianjin and Wuhu**
- **World #1 in LED wafer production**
- **Produces multiple billion LED chips per month**
- **Supply assurance from over 1.3M Sq. meters of manufacturing operations**
- **~$9B market cap**
- **Over 1,000 R&D staff**

# San'an Optoelectronics

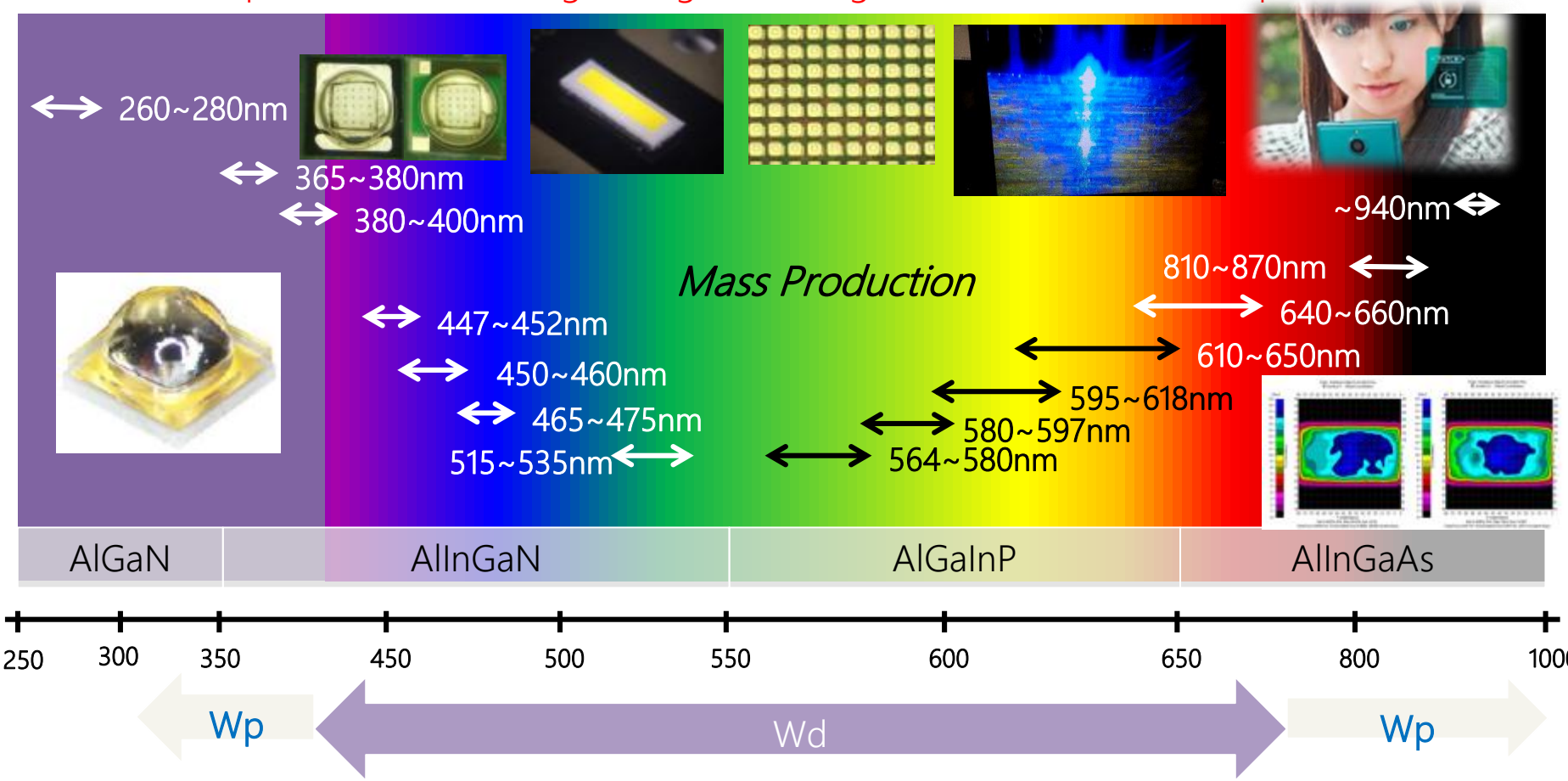
# San'an Optoelectronics – chip & wafers




——Focus on III-V compound semiconductor epitaxy, chips, applications.

# San'an Optoelectronics – WL range

Sanan can provide full wavelength range including visible and non-visible spectrum LEDs



# LIGHT FOR LIVING

## ILLUMINATION LEDs

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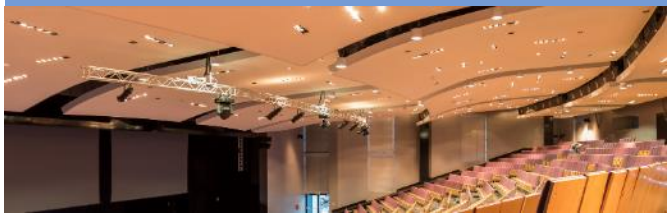
### RETAIL

### HOSPITALITY

### RESIDENTIAL

### INDUSTRIAL & OUTDOOR

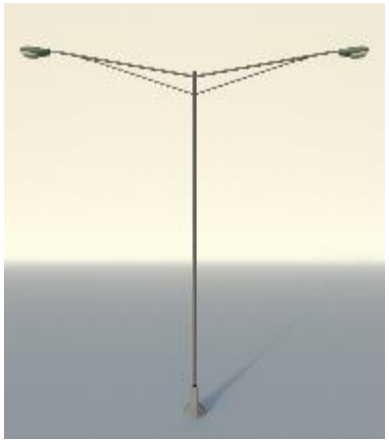
### OFFICE & EDUCATION



### MUSEUM & ARCHITECTURAL

LIGHT FOR LIVING

# Light for Living – illumination markets


Retrofit Bulb

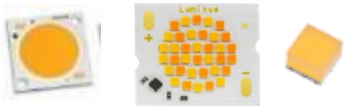
Street Lighting

Area Lighting

Retail Shop

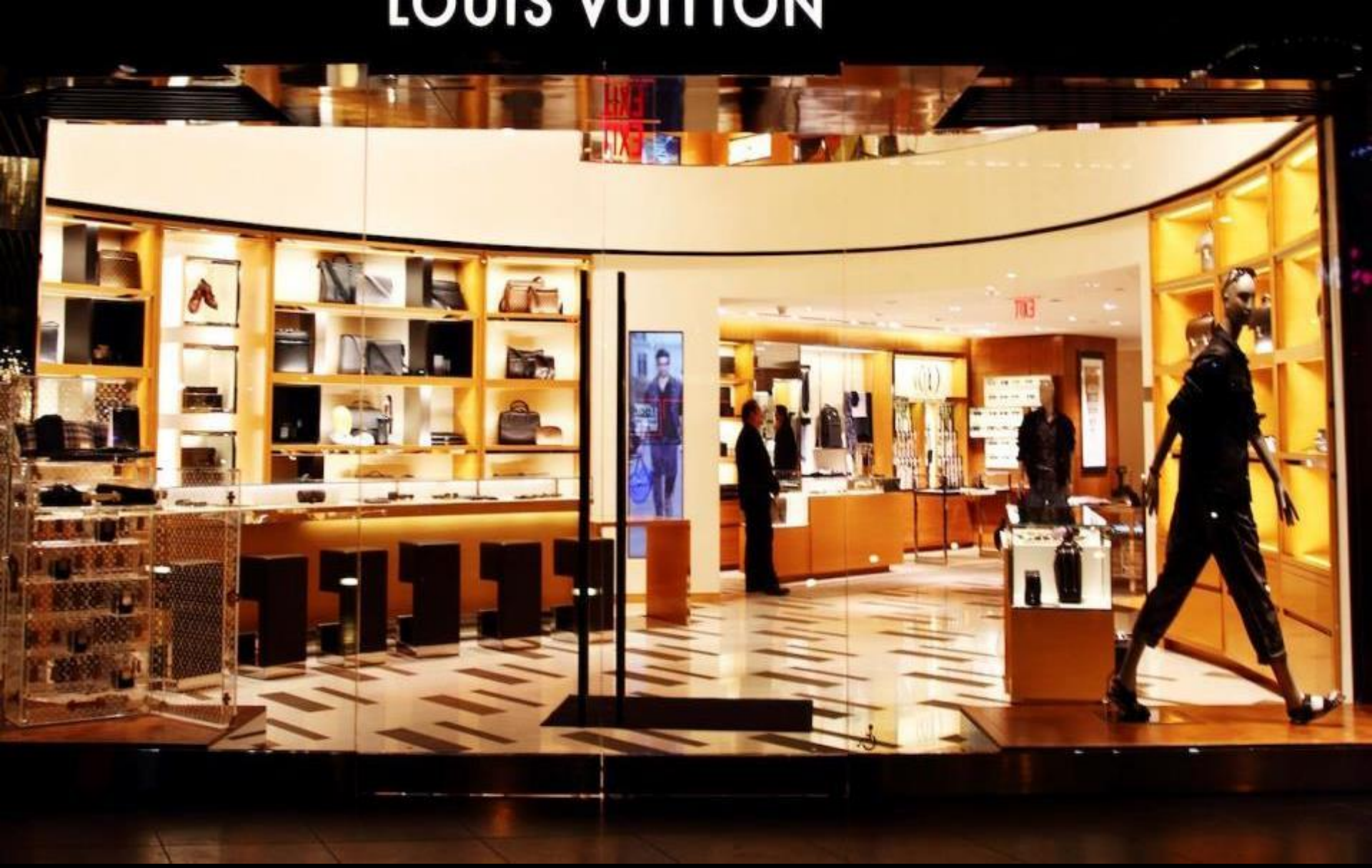
Commercial

Hospitality



## Illumination Lighting Markets

**Light for Living**
Quality of light, color consistency, high efficacy




**World class quality of light and performance in retail applications**

Luminus light quality and high output make cooler, more efficient studio lighting a reality.

# LIGHT FOR WORKING

SPECIALTY LEDs

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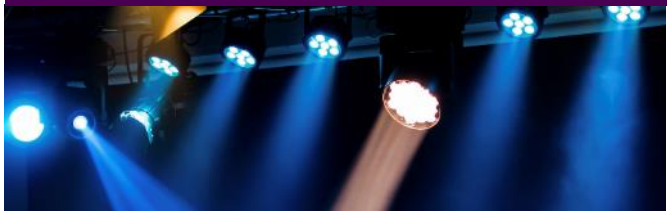
## ULTRAVIOLET

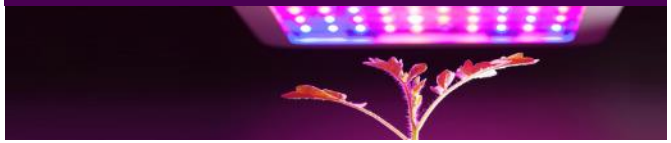
## STAGE



## INFRARED

## DISPLAYS

## HORTICULTURE



## INDUSTRIAL

## MEDICAL

# Light for Working – specialty markets

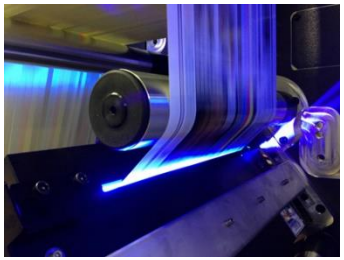












Display

Industrial

Automotive

Medical

IR

UV Curing

Horticulture

Entertainment

Specialty Lighting Markets

**Light for Working**

High flux/mm$^2$

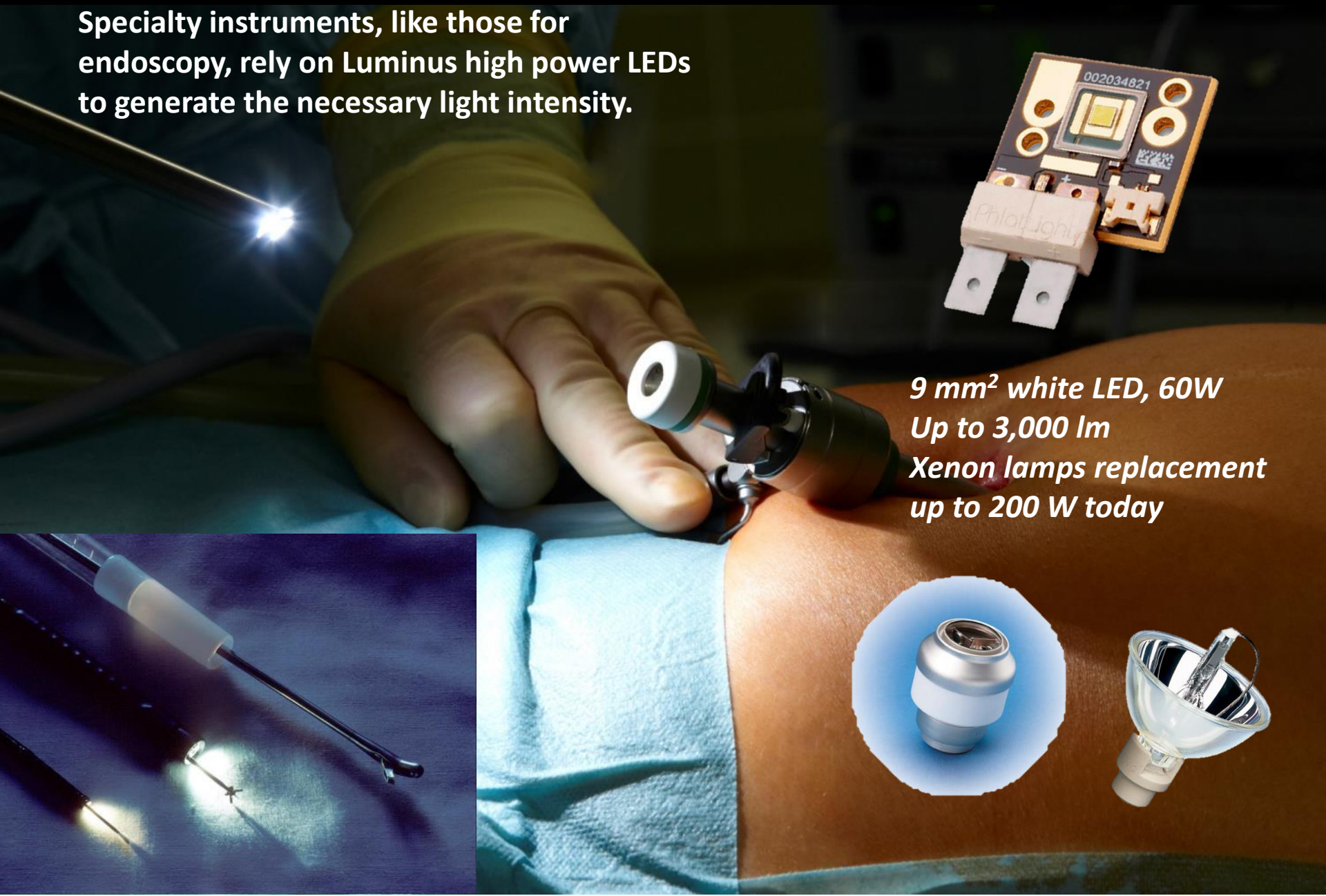
LUMINUS


**Trusted reliability in applications like the B787 Dreamliner heads-up display**

**Luminus lights proudly from atop the Freedom Tower in NYC**

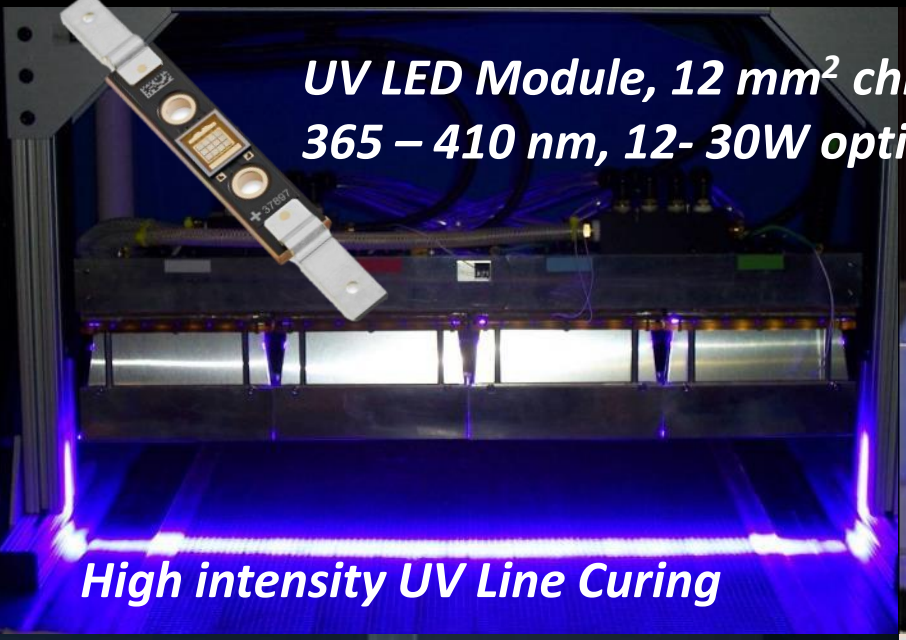
# Medical Endoscopy and Fiber Illumination

**Specialty instruments, like those for endoscopy, rely on Luminus high power LEDs to generate the necessary light intensity.**



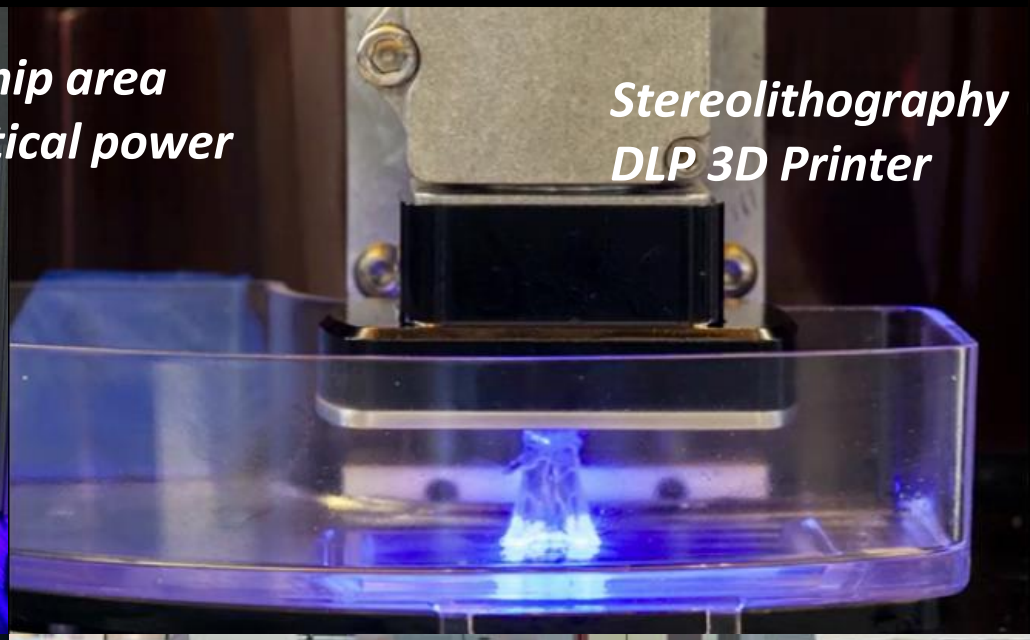

***9 mm² white LED, 60W***
***Up to 3,000 lm***
***Xenon lamps replacement***
***up to 200 W today***

# Industrial UV Curing Applications



*UV LED Module, 12 mm² chip area*
*365 – 410 nm, 12- 30W optical power*

*High intensity UV Line Curing*

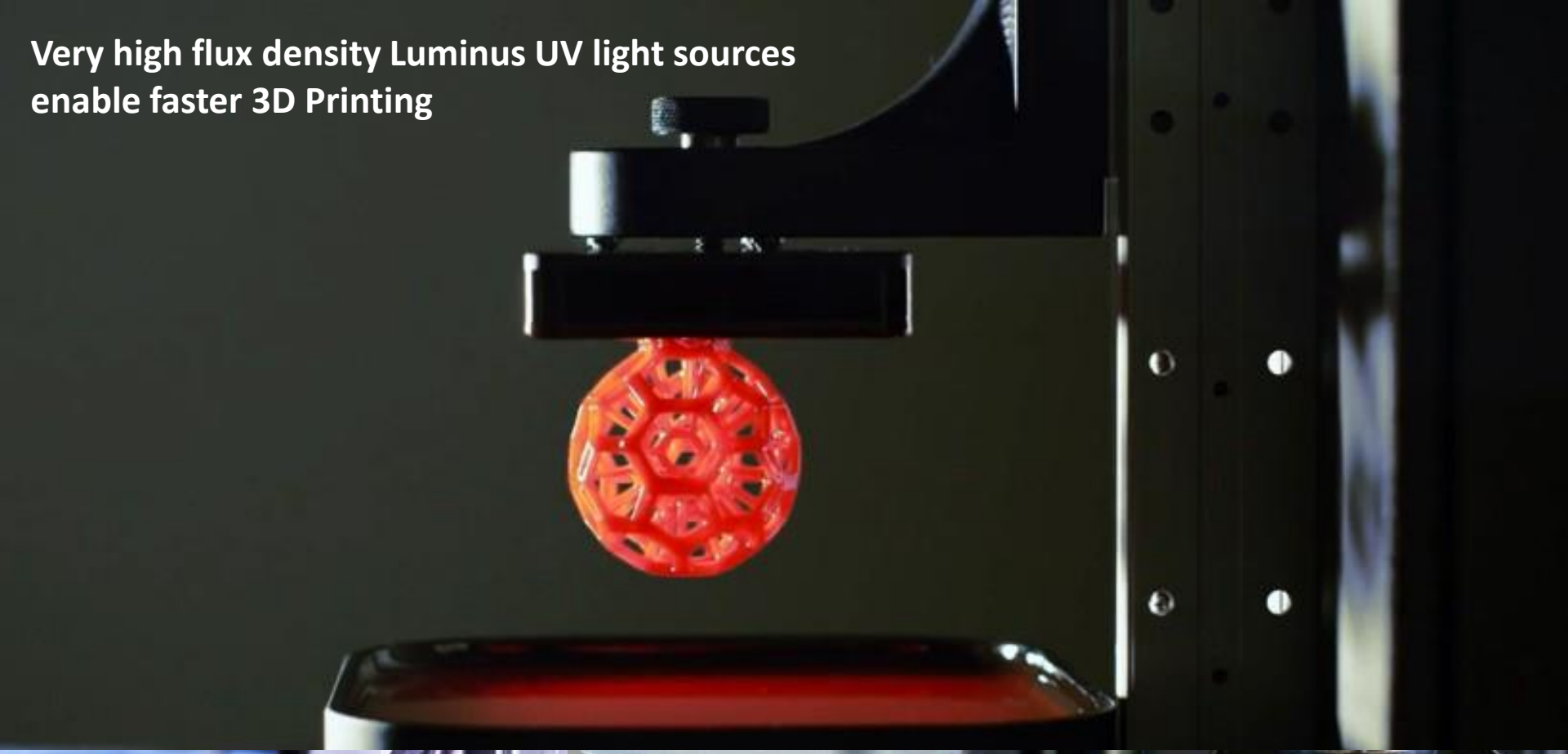


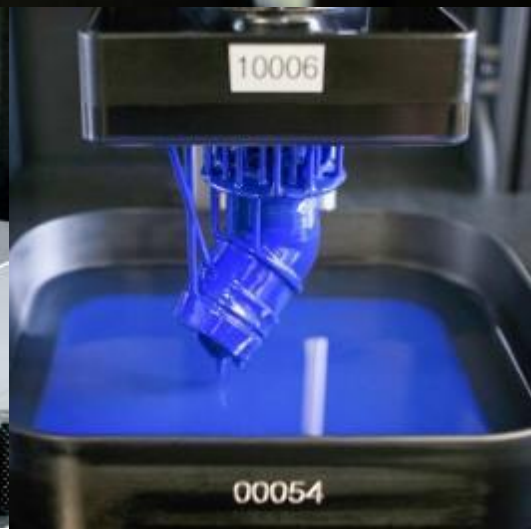
*Stereolithography*
*DLP 3D Printer*

*Wood, laminates etc*

*Printing*
*Ink Curing*

**Very high flux density Luminus UV light sources enable faster 3D Printing**



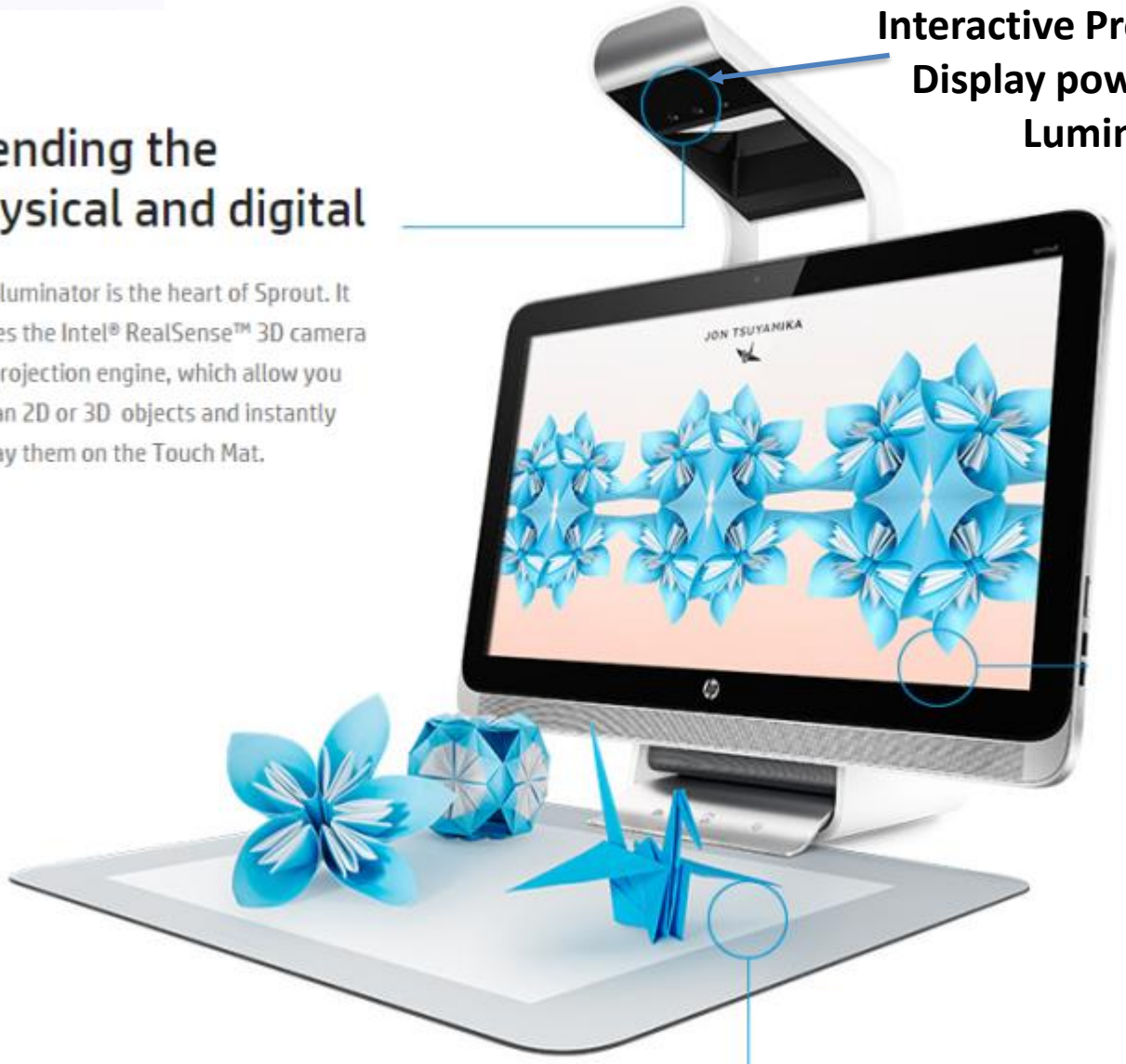

# Luminus is enabling broad use of embedded Pico Projectors

## a more intuitive, natural way to work

**Interactive Projection Display powered by Luminus LEDs**

### blending the physical and digital

The Illuminator is the heart of Sprout. It houses the Intel® RealSense™ 3D camera and projection engine, which allow you to scan 2D or 3D objects and instantly display them on the Touch Mat.

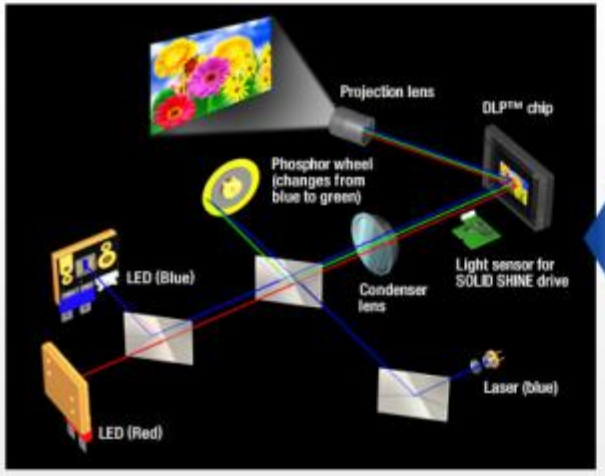



**“Pico” Projectors that use LED light sources offer smaller form factors and better color**

# Luminus is helping the LED assisted Front Projection market provide better color at better efficiency



PT-RZ470/RW430 Optical Structure Image




# Architectural - Fountain Lighting


***High-Intensity "Water Canons" – Hyperdirectional spotlight***
***14 mm² White LED, up to 5000 lm - ~ 350 lm/mm²***

# Scalable & Flexible Supply Chain

Luminus is a fully integrated LED manufacturer

- Production Facilities
  - Wafer Fab – San'an Optoelectronics
  - Pilot assembly production and NPI in California
  - CM - Assembly & test in Asia for volume production
- Manufacturing Standards & Certifications
  - ISO 9001:2008 certified
  - ISO 17025/LM80 certification
  - 100% RoHS & REACH compliant
- Strategic supply chain aligned for cost-effective, high-volume manufacturing of US developed technology and products.

Prepared to respond to any volume on demand

# Certified Reliability Testing

Strong reliability track record for power LEDs

- NVLAP Accredited Testing Facility
  - NIST accredited laboratory certification
  - In-house LM80 for TM-21 testing
- Extensive reliability test data for Specialty products at current densities up to 3.5 A/mm$^2$
- High-power chipsets deployed in 24/7 applications for over 4 years demonstrating excellent MTBF
- Extensive qualification testing

# Strong IP Position

> 358 Global Patents Granted

**Luminus Devices Patents (many strong fundamental patents)**

- >70 global patents granted

**New Patent acquisition (November 2014)**

- 138 patents granted including epitaxy and chip from a global LED company exclusively licensed to Luminus

**Sanan Patents**

- >150 global patents granted

# Thank You