



Quantum Dot Solutions for Lighting and Display Applications

Frank Ignazzitto

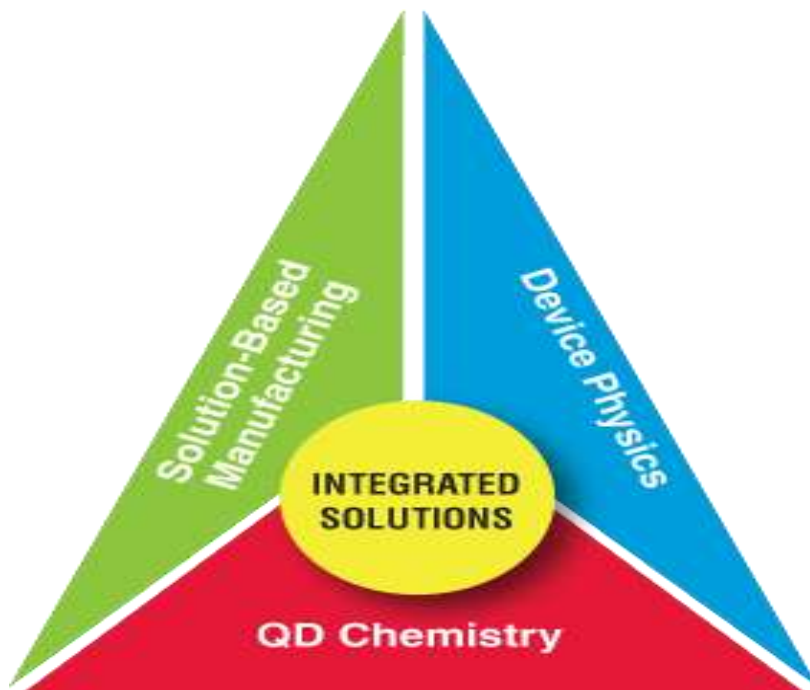
APEC Conference

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QD Vision's Focused & Integrated Approach

The **only** quantum dot company focused solely on displays & lighting

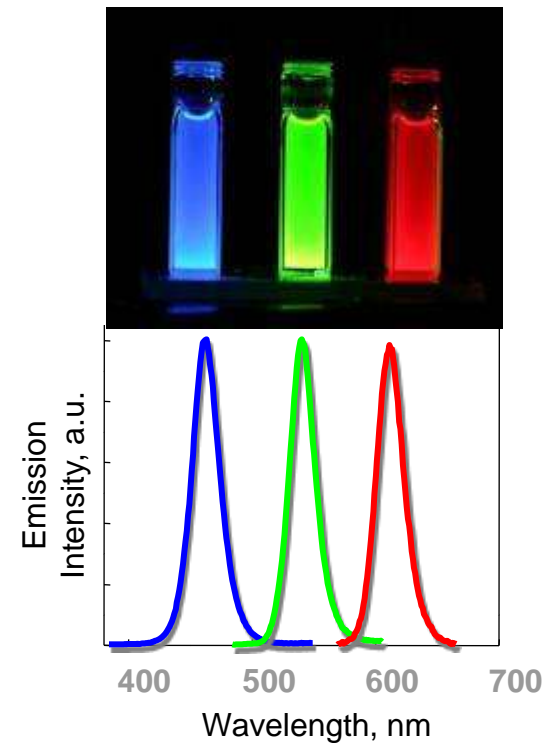
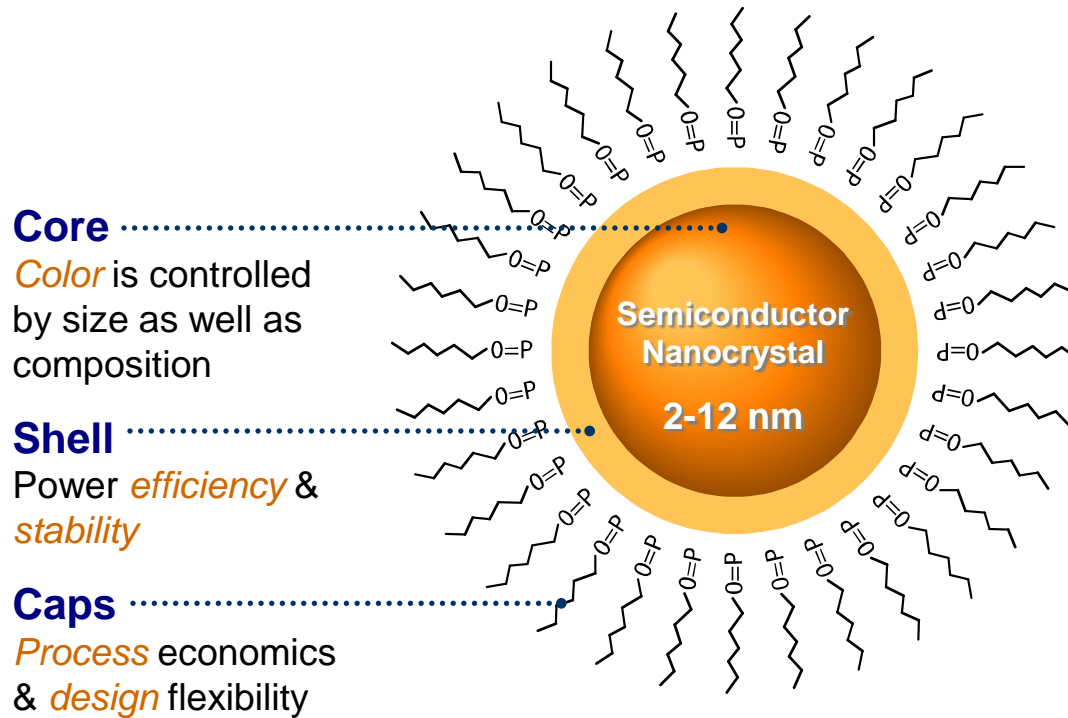


- Founded in May 2005 - MIT roots
- 74+ employees - R&D transitioning to operational focus
- Moved into new 59k ft² facility
- IP from MIT license, Motorola patent acquisition, and QDV filings
- VC funded, ~\$55M raised to date

The 1st quantum dot company to market in lighting

Quantum Dot Semiconductor Nanocrystals

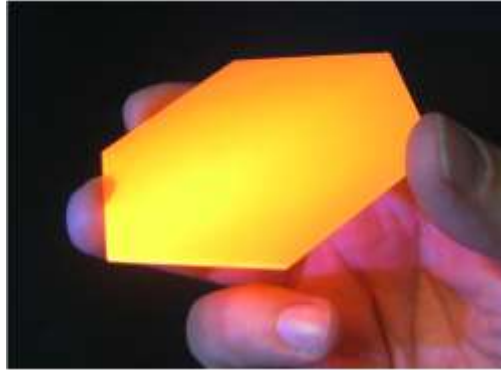
A practical solution to deliver light with extraordinary color & efficiency



QDs operate in two modes

Photoluminescence (PL mode)

- Activated by light energy
- Conversion of color from other light sources
- Any light with shorter wavelength (higher energy)



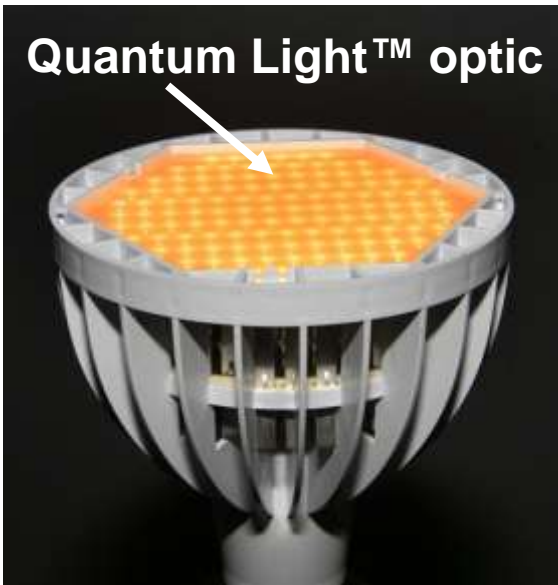
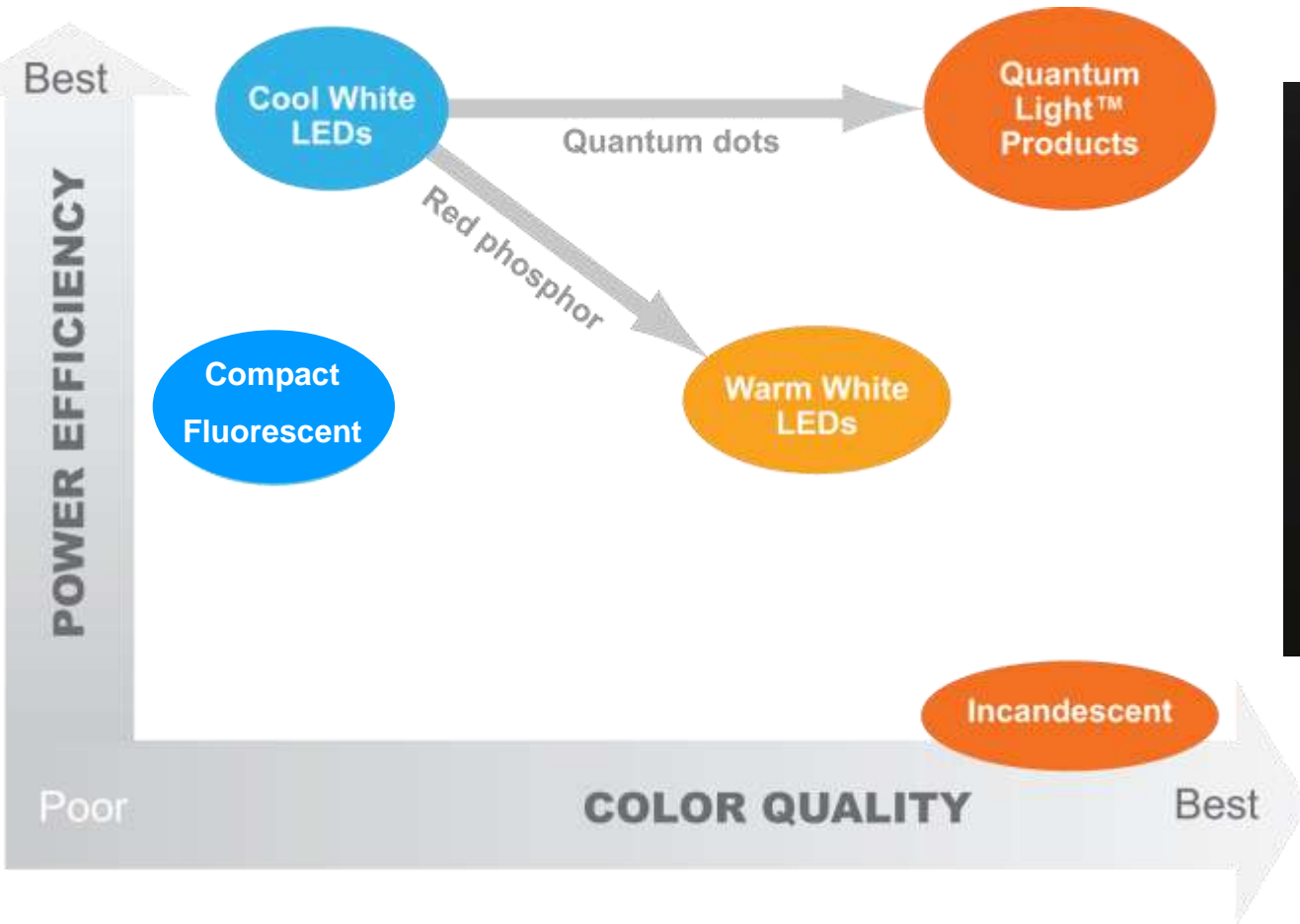
Electroluminescence (EL mode)

- Activated by electronic energy
- Direct emission of colored light
- Requires charge transfer films
- “QLEDs”



QD Optic Enables Highest Performance Lighting

Quantum Dots break tradeoff paradigm



Nexus R30 LED Array
2700K, 90+ CRI,
>60 LPW



Nexus Lighting and QD Vision Unveil
World's First Commercial Quantum Dot/LED
Lamp Line -- May 5, 2009



Illuminated by
Incandescent Bulb

Cool White LED

Warm White LED/QD Optic



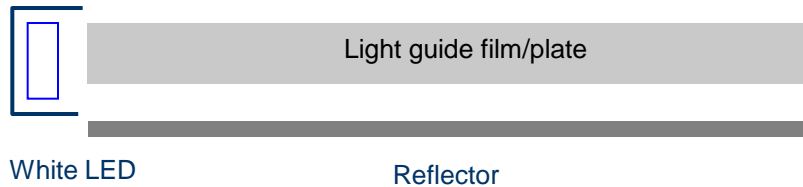
LED/QD Optic Lamp that integrates quantum dot technology
Combines warm, rich color of QD emission with LED Efficiency,
providing 2700K, 90+ CRI at 60+ Lumens Per Watt



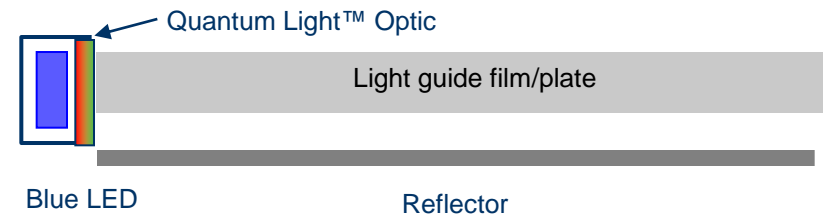
Quantum Light™ optic for LCD backlighting

A drop in solution with disruptive benefits

Current White LED Solution



Quantum Light™ Solution in an LCD Backlight Unit

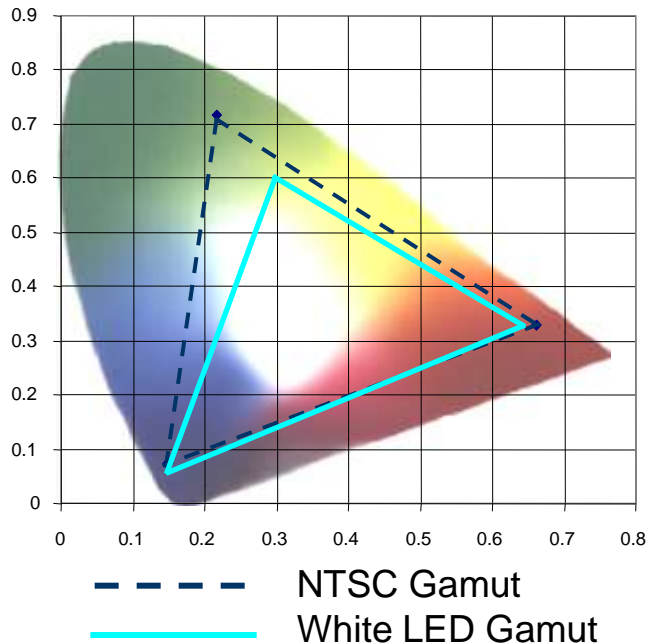


- **Design:** Drop-In solution; ultra-thin form factors
- **Color:** Visually impressive improvement (70's% → 100+% gamut)
- **Power:** Possible savings of up to 33% (H-K effect)
- **Cost:** Possible savings of up to 50% in LEDs (fewer, cheaper)
- **Enviro:** RoHS Compliant

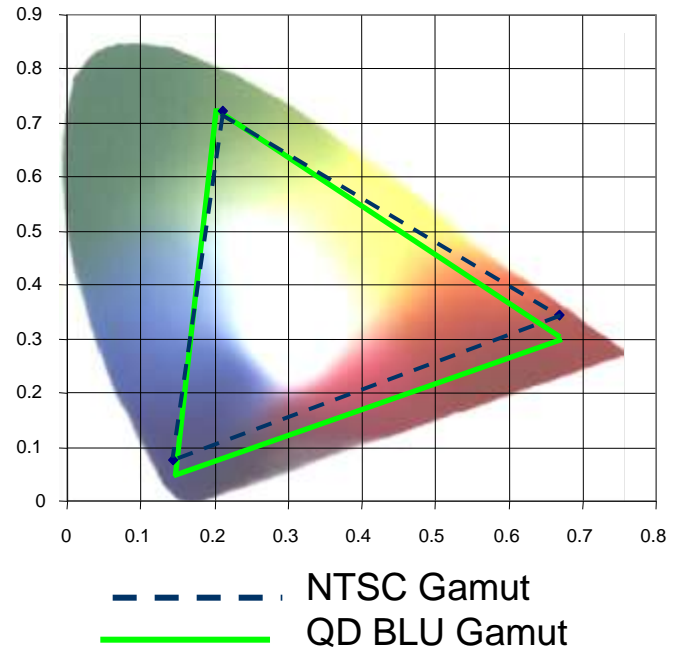
Quantum Light™ ink widens LCD color gamut

Dramatically improves color vs. white LEDs

White LED BLU
mid-70% NTSC

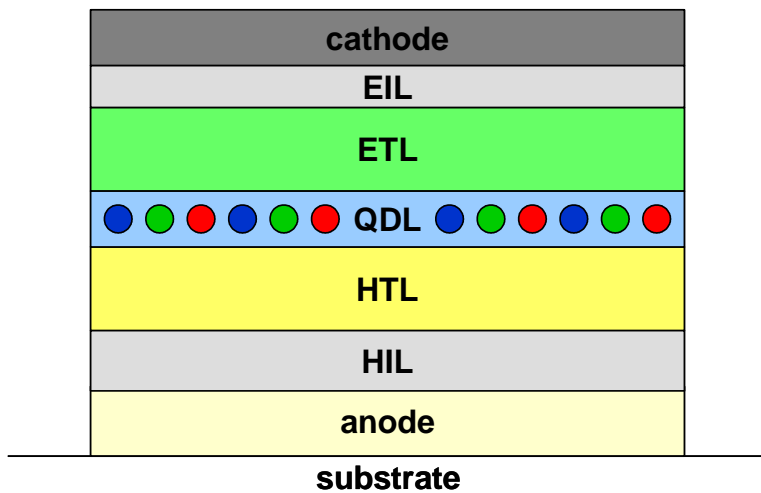


QD-enhanced BLU
>100% NTSC

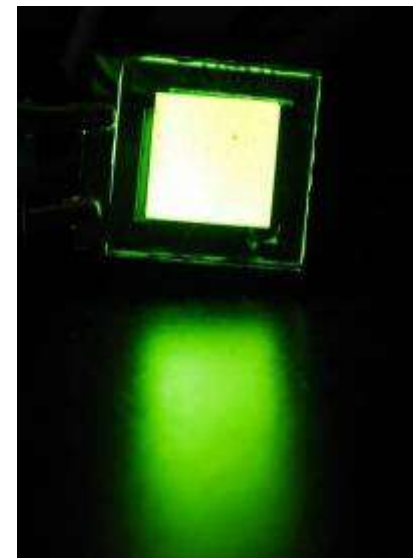


While improving power efficiency by up to 1/3rd

Quantum dot light emitting diodes



Device Structure



“A printable thin film LED technology with exceptional color, high brightness and excellent power efficiency.”



QLED Advantages for Displays

Excellent color purity

- Wide-color gamut
- No need for color filters
- No need for microcavities

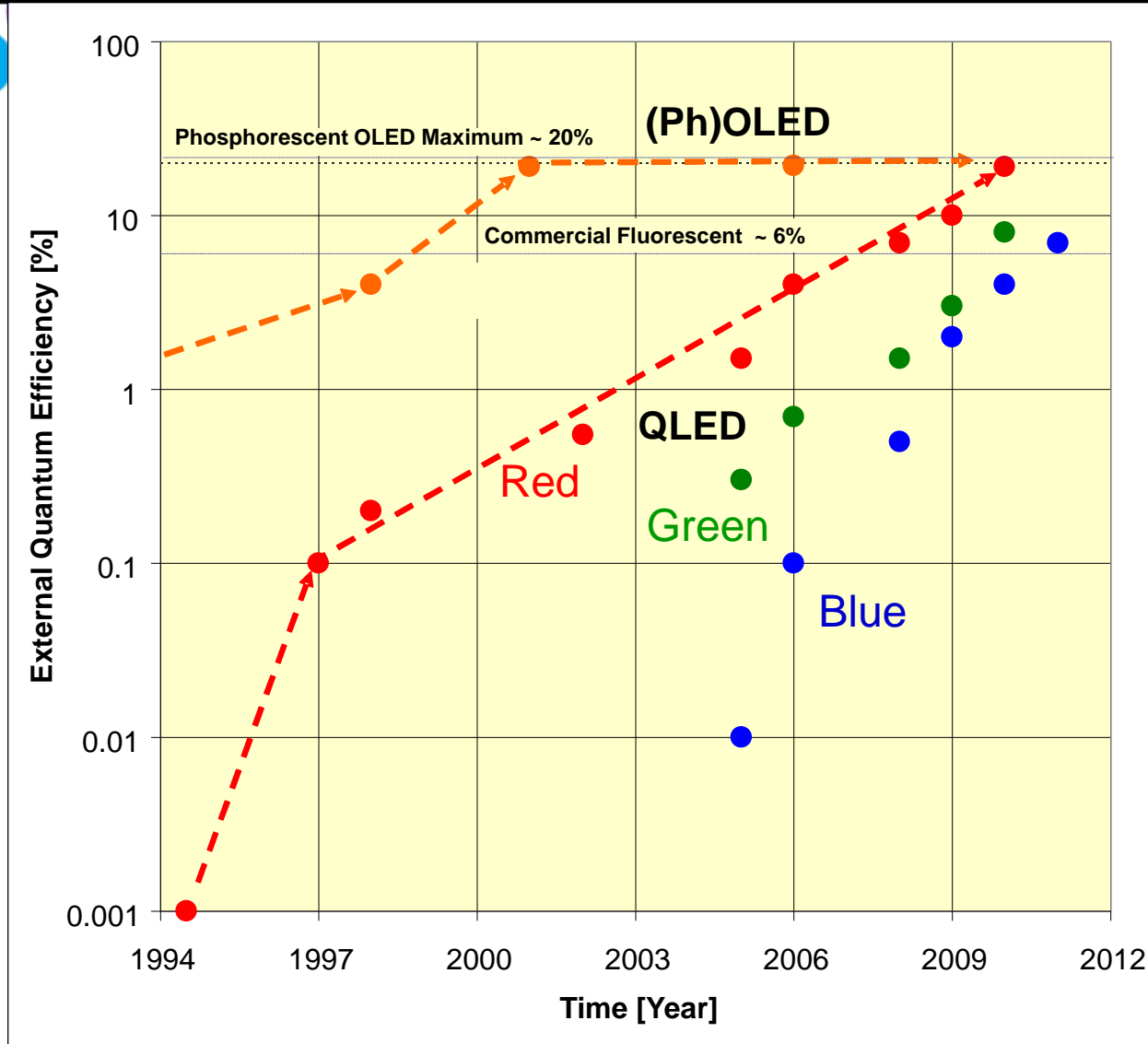
Low power consumption

- Low-voltage driving
- Highest lumen/photon

Simple construction

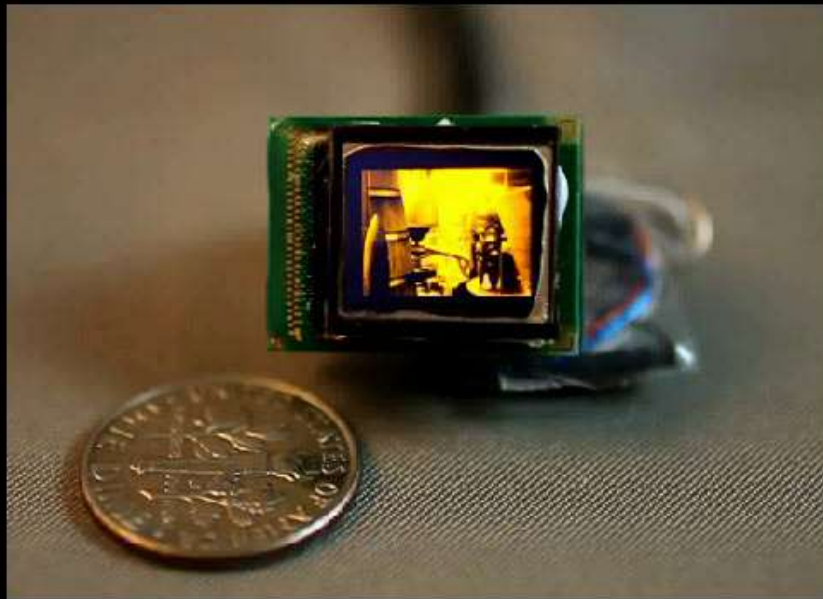
- No backlight or color filters
- Printable Layers
- Simpler BOM

Progress in QLED Development



EQEs shown are without outcoupling enhancements

QLED Microdisplays



Why QLED?

- **Power efficiency directly translates to SWaP reduction.**
- **Color purity and tunability allows for better selection for nighttime use, scotopic response.**

Transparent QLEDs



Why QLED?

- **Transparent device** → importance of optical stack, secondary optics.
- **Monochrome QLED spectrum** results in less chromatic aberration through secondary optics, simpler refraction.

Infrared QLEDs

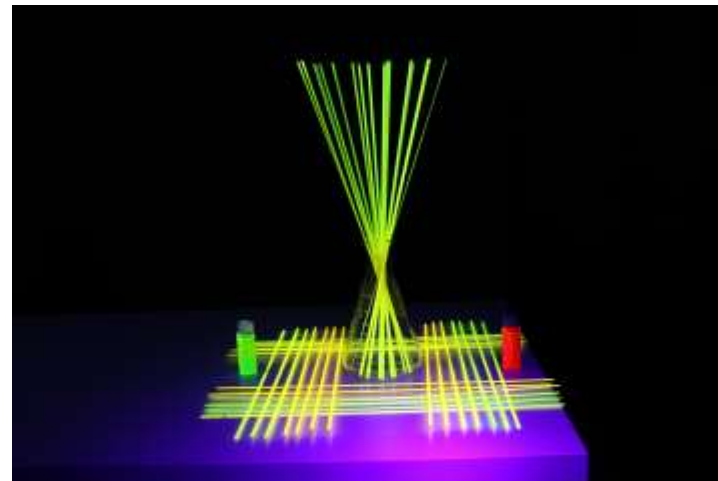
Why QLED?

- **No wasted photons as all generated light is in infrared (without filters).**
- **Currently tunable through NIR and SWIR.**
- **Only efficient, large area IR emitter technology.**



QD Vision Summary

- **Revolutionary technology**
- **Extensive patent portfolio**
- **World class team**
- **Practical, integrated solutions**
- **Mission-critical focus**
- **Top tier partners**





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