Manufacturing Methods for Connected Lighting Luminaire

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Discussion Topics

- EATON Lighting: Who & What we do?
- Efficacy Roadmap
- Market Drivers & Barriers
- Luminaire Manufacturing Methods
- Manufacturing Process
- Manufacturing future: Additive Mfg
- Recommendations
EATON Lighting: Who & What we do?

- LED’s
- Driver
- Optic Design
- Photometric Qualification
- Application Layouts
- UL Certification
- DLC Certification
- Energy Star
- Distributors
- Utility Channel
- Cast Products
- Metal fabricators
- Plastic Molding
- Dept. of Transportation
- Lighting Designer’s
- Controls
- IOT
- Luminaire

Rubber meets the Road!

Picture Source: https://henrykh.wordpress.com/2010/06/16/rubber-meets-the-roadrecovering-to-stake/
Luminaire: Cost / Efficacy Roadmap

DOE Solid-State Lighting Research and Development
Multi-Year Program Plan, April 2014.
*Fit lines added

Black Line = LED
Grey Line = Luminaire
Brown Line = Controlled Luminaire (added)
SSL Market Drivers / Barriers for Adoption

- **Cost Reduction** (Lm/$) (First Cost)
- **Manufacturability** (DFM, Throughput) (Compatibility)
- **Reliability** (L70)
- **Performance** (Lm, Lm/W) (Color Quality)

**Energy Savings**
Luminaire Assembly

Manufacturing Process & other are significant contributors to Total cost!
Luminaire Manufacturing Methods

**Casting**
- Higher Cost
- Complex shape
- Limitation
- Good Structural & Thermal properties
- Painting needed
- Aesthetic oriented designs

**Molding**
- Lower Cost
- Good for optic needs
- Pre-painted parts
- Poor Thermal conductivity
- Aesthetic oriented designs

**Sheet metal Fabrication**
- Lowest Cost
- Pre-painted parts
- Poor Thermal conductivity

Subtractive Process!!
Future Manufacturing Process

Future Processes: No Material Wastage
Future Manufacturing Process

3D Metal / Plastic Printing

Source: Pictures from above publication

Printed Electronics

Source: Georgia Tech presentation

Printed Optics

https://3dprint.com/88316/wacker-3d-printed-silicone/

Additive Manufacturing: Metal, Plastic, Printed Electronics….
Eliminate Manufacturing Redundancy

Quicker to Market & Low manufacturing cost!!
Electronic Circuit Board : Manufacturing

MCPCB Process Flow
Subtractive process

- Photoresist
- Exposure
- Developing
- Etching
- Strip

Thick Film Process Flow
Selective additive deposition

- Al plate
- Dielectric
- Conductor

- Reduced processing steps
- Less material consumption (print only where needed)
- Simplified bill of materials (single-part dielectric system)
- Quick and inexpensive design changes
- Inert glass/metal system—No flammability issues

Picture Source:
https://www.led-professional.com/products/mechanics/heraeus-celcion-r/@@images/05435290-d2f5-4a63-b4f2-76e1ae9177ea.jpeg
DOE Funded Project: Thick-Film Integrated Mfg

Thick-film additive manufacturing process to print circuits for luminaires

Thick Film Lab

Integrated Module

Thick-Film LED

(DOE Proj. NO. DE-EE0006260)
Additive Mfg initiative ⇒ Print on Demand

Print on Demand Manufacturing Process for Connected Lighting...

- Low Cost
- High Efficacy
- High Reliability
- Aesthetic
- Solar Powered
- Print on Demand
- Sensors Integrated
- Controls Integrated
- Daylight control
- Light Weight
- High Efficient

Solution: Integration
Recommendation to DOE

PC / Mobile Industry

Connected Solutions!

Module based (past)  Integrated construction (future)

Lighting Industry

Fund Projects to encourage:

Integrated Solutions + Additive Manufacturing
Thank You!

EATON

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