

2015 Solid-State Lighting R&D Workshop

Workshop Mission

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Morgan Pattison, Ph.D.

SSLS, Inc.
Technical Advisor
DOE SSL Program

SSL Program Process

Industry input from Roundtables and Workshops shape DOE priorities and solicitations



LED Roundtables Highlights

Basic Science – Core Research

Critical Challenges

- Improved Down Converters
- Materials Discovery
- Red and Green LEDs
- Substrates
- Characterization and Analysis
- Novel Device Architectures

Product Dev. – Manufacturing R&D

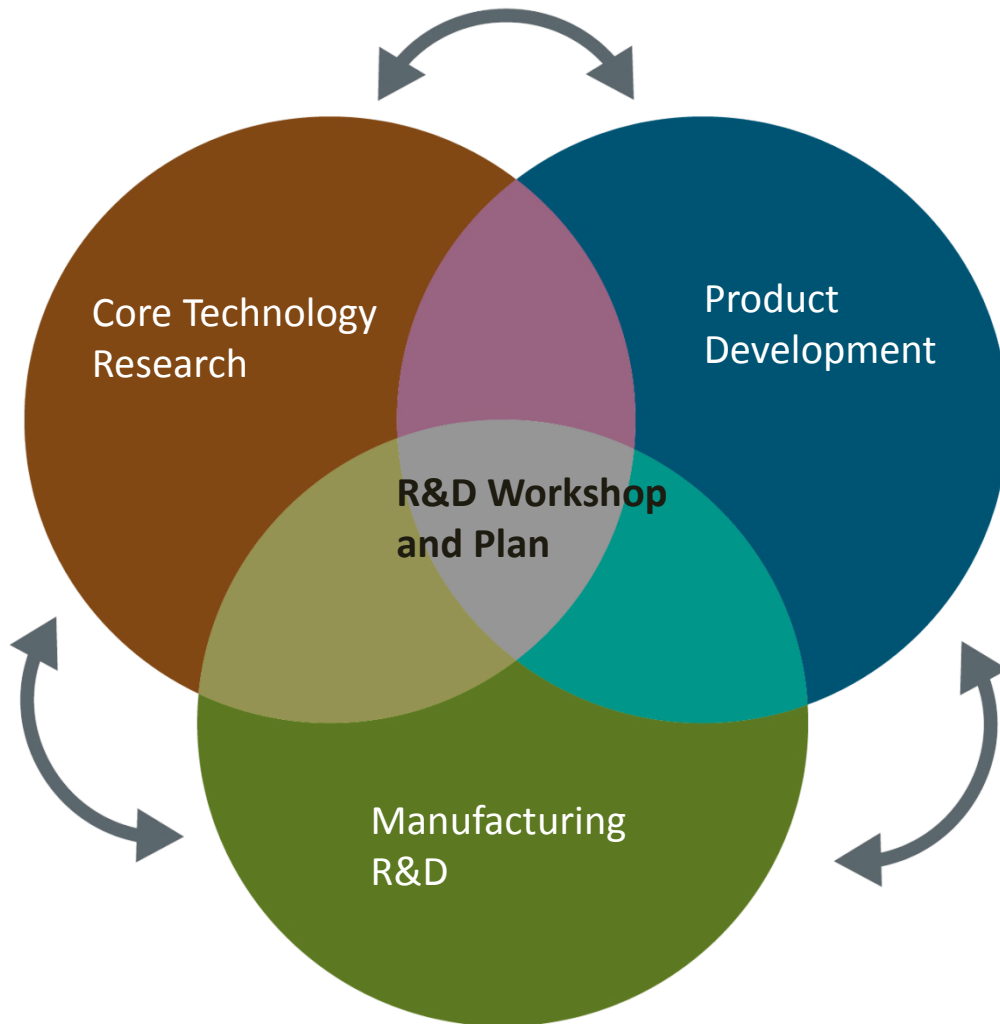
Critical Challenges

- Substrates
- Down Converters
- New Materials
- LED Drivers and Passive Components
- Advanced Packaging
- Color Consistency, Reliability, and Lifetime

OLED Stakeholder Meeting Highlights

Critical Challenges

- Market, Education, and Outreach
- OLED Materials
- OLED Light Extraction
- OLED Substrates, Integrates Substrates, and the Move Toward Flex Lighting
- OLED Products and Drivers
- OLED Manufacturing



One SSL R&D
Workshop
&
One SSL R&D
Plan

Workshop Mission

Gather inputs to shape DOE SSL priorities and R&D funding

- Hear from leading technology speakers
 - Big picture to technical details
- Ask questions, contribute to the discussion
- Provide your inputs
 - Comment cards
 - Topic Tables/OLED Priorities Session
 - Questions to Consider

DOE Solid-State Lighting Program Mission and Goal

MISSION

Guided by a government-industry partnership, DOE's mission is to create a new, U.S.-led market for high-efficiency, general illumination products through the advancement of semiconductor technologies, to save energy, reduce costs, and enhance the quality of the lighted environment.

GOAL

By 2025, develop advanced SSL technologies that — compared to conventional lighting technologies — are much more energy efficient, longer lasting, and cost competitive, by targeting a product system efficiency of 50 percent with lighting that accurately reproduces sunlight spectrum.

Comment Cards

2015 R&D WORKSHOP COMMENT CARD

Check the appropriate box to indicate what your comment relates to. One comment per card, please!

- A specific topic/task (which?) _____
- One of the “Questions to Consider” Topic Area: _____ Question #: _____
- What you’d like to see in the new R&D Program Plan
- Program Milestones Other *Name (optional):* _____

Remarks:

Please return completed cards to the Registration Desk at any time during the workshop.
(Extra cards also available there.)

LED Topic Tables

Procedure

1. Decide which topic you would like to discuss from the following list:
 - Substrates
 - Emitter Materials
 - Down-Converters
 - LED Packaging
 - New Materials
 - Novel Device Architectures
 - LED Drivers
 - Reliability & Color Consistency
 - Test & Inspection
 - Controls & Smart Lighting
 - Advanced Luminaires
2. Take a seat at the relevant topic table. Add your name to the Sign-In Sheet and join in the discussion. Additional tables will be provided for more popular topics.
3. Identify a spokesperson and scribe. The spokesperson will provide a brief report on the key outcomes of the discussion using the PowerPoint template provided at the table. The scribe will collect answers to the main questions on the Feedback Form.
4. Explain why this topic is important. Why is it more or less urgent than the other topics?
5. Discuss the technical challenges. Some “Questions to Consider” for each of the topic tables are included below to spur the discussion. Review the Roundtable Reports for further background.
6. Summarize the critical technical challenges that need to be addressed over the next 3–5 years.
7. For each critical technical challenge, identify where the primary focus should be placed on a scale of 1–5, where 1 = Basic Science and 5 = Manufacturing R&D.
8. Review the “Metrics and Previous Comments” on page 7 for your specific topic. These are taken from the existing tasks. Are the metrics still relevant, appropriate, and achievable? Add new metrics as necessary. Create or update values for the current status and 2020 targets.
9. List specific examples of the type of research that would advance this topic on the Feedback Form.
10. Comment on the top level “Program Milestones” on page 6. Are they still relevant, appropriate, and achievable? Are they consistent with the topic milestones? Update as necessary.

OLED Priorities Session

“OLED Priorities” Session Objectives

1. Discuss OLED R&D tasks that are pertinent to the mission of SSL development worldwide. Convey relevant details, updates, and progress associated with tasks. Nominate new tasks, if any, for discussion.
2. Provide a sense of the relative importance of the tasks, regardless of DOE funding availability. Specifically state the reasoning behind the task ranking. (Why is the task important? Why is it more or less urgent than others?)
3. For selected priority tasks, provide the current status of metrics of the task and recommend any necessary changes to the goals or task description.
4. Review the OLED Milestones and update as needed.
5. Provide further comments and questions on any issues or tasks (see “Questions to Consider” and task list below for a starting point) that warrant discussion in the 2015 SSL Report.

Homework



Questions to Consider

1. What are the key technological challenges that are obstacles to OLED adoption?
2. Which R&D efforts could offer the biggest impact in the near term?
3. What areas of R&D have potential for transformational impact in the long term?
4. Is flexibility/conformability necessary for OLED adoption (due to cost savings or added feature value?)
5. What R&D efforts will best promote and which is most urgent:
 - a) Reliability?
 - b) Manufacturing yield?
 - c) Power efficacy improvements?
6. What were the most significant R&D achievements in the past few years?
7. How far should we go down R&D paths before a set stack structure/standard panel emerges (i.e. pursuing many different approaches for light extraction, substrates, encapsulation, anodes, drivers that may not be compatible with dominant approaches to manufacturing)?
8. Are we at the point where OLED specific drivers are necessary?
9. How practical is it to directionalize the light from OLEDs, either internally or externally?
10. OLED standards – what is the status?
11. To what extent should DOE be involved in supporting standards development?
12. OLED products – what can we expect in 2015? 2017? 2020?
13. DOE milestones – are we on track? If not, what R&D issues are preventing progress?
14. How can DOE promote more international cooperation on OLED lighting?
15. Are DOE Milestones for 2017 and 2020 appropriate?
16. Major manufacturer milestones target \$10/klm? Is this possible?
17. What opportunities are there for synergy with other applications in developing new manufacturing methods?

Prepare your thoughts and share them with the group and/or directly with the DOE using comment cards or email – SSLWorkshop@akoyaonline.com

Background Materials

Program Milestones

Year	Milestones
FY10	Package: >140 lm/W (cool-white); >90 lm/W (warm-white); <\$13/klm (cool-white)
FY12	Luminaire: 100 lm/W; ~1,000 lumens; 3500K; 80 CRI; 50,000 hours
FY15	Package: ~\$2/klm (cool-white); ~\$2.2/klm (warm-white)
FY17	Luminaire: >3,500 lumens (neutral-white); <\$100; >150 lm/W
FY20	Luminaire: 200 lm/W Smart troffer with integrated controls: <\$85

Note: Packaged devices measured at 25°C and 35 A/cm².

What's Missing?

Are they up to date?

Is there a better way to describe progress?

Task Descriptions and Metrics

Down-Converters

Metrics	2013 Status	2020 Target
Quantum yield (25°C) across the visible spectrum	95% (Green) 90% (Red)	99% (Green) 95% (Red)
Thermal stability – Relative quantum yield at 150°C vs. 25°C	90%	95%
Average conversion efficiency ³ (pc-LED)	70%	74%
Spectral FWHM	100 nm (Red)	<30 nm for all colors

SSL Program R&D Plan

Inputs from Roundtable meetings and Workshop shape the DOE SSL R&D Plan annual update

