RESEARCH ON MEASUREMENT METHODS FOR ORGANIC LIGHT-EMITTING DIODES

TOKI KAWABATA

KONICA MINOLTA HOLDINGS, INC. JAPAN
National Institute of Standards and Technologies USA
Who is Toki?

* Belong to KONICA MINOLTA HOLDINGS, INC
* Developed color and light measuring instruments since 1987
* Guest researcher in NIST since Jan. 2012
* Interested in the practical methods for OLED lighting
* An active member of IESNA
AGENDA

1. OLED Samples
2. Test result with 1m sphere
3. Test result about angular shift
4. Issues about OLED measurement
1. OLED Samples

7 samples from 6 manufactures

Kaneka
KONICA MINOLTA
Lumiotec * 2 items with different CT
OSRAM
Panasonic Idemitsu
Philips
2. Test result with 1m sphere

2-a. System for measurement

1m sphere with temperature controlled (SPR-600)
Irradiance spectro-radiometer (CS-2000A)
Power supply (E3617A)
IR thermometer (DT-8380)
2-b-1 Relative Luminous Flux

Luminous Flux

Relative Luminous Flux

B-2 | B-3 | B-4 | B-5 | B-6 | B-7 | B-8

Values:
- B-2: 40
- B-3: 20
- B-4: 80
- B-5: 80
- B-6: 100
- B-7: 20
- B-8: 20
2-b-2 Relative luminous Efficacy (lm/W)
2-b-3  Relative Area Efficacy (lm/cm²)
2-b-4  color coordinate $x, y$

```
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+
```

```
0.3600 0.3700 0.3800 0.3900 0.4000 0.4100 0.4200 0.4300
```

```
B-2  B-3  B-4  B-5  B-6  B-7  B-8
```

```
x
```

```
y
```

```
0.3000 0.3500 0.4000 0.4500 0.5000
```

```
x
```

```
y
```

```
0.3600 0.3700 0.3800 0.3900 0.4000 0.4100 0.4200 0.4300
```

```
B-2  B-3  B-4  B-5  B-6  B-7  B-8
```
2-b-5 color temperature

CT

2000 2500 3000 3500 4000 4500 5000

B-2 B-3 B-4 B-5 B-6 B-7 B-8
2-b-6 Ra

Ra
2-b-7  R9
2-b-8  Relative spectral irradiance
2-b-9 Summary

Luminous Flux

Luminous Efficacy (lm/W)

Area Efficacy (lm/cm²)

R9

Ra
2-c  Issues

2-c-1. Position dependent or Sphere error?

Position VS Relative Luminous Flux
2-c-1. System for measurements on different positions

1m tube coated black inside color and luminance meter (CS-100)
Power supply (E3617A)
IR thermometer (DT-8380)
2-c Issues

2-c-2. Long time needed until stable

System $2\pi$ geometry with temperature controller may be useful.
2-c  Issues

2-c-3. Data related to temperature?

System $2\pi$ geometry with temperature controller will be useful.
3. Test result about angular shift

3-a. System for measurement

Rotating stage + angular sensor (ESP-300)
spectro-radiometer (CS-2000A)
Power supply (E3617A)
IR thermometer (DT-8380)
3-b-1 Angle VS Luminance

Lv 0-80 degree

C-02

C-08
3-b-2  Angle VS x,y

xy 0-80degree

- C-02
- C-08
4. Issues about OLED measurement

Angular Luminance + color shift of OLED must be measured.

The best condition for measuring OLED should be researched.
  Temperature, Geometry, Sphere position error

How should MURA (Luminance and color uniformity) be evaluated?

What should be defined for life time?
  Spot error could be occurred.
Q&A

Your opinion and suggestion are welcome.
Thank you for your attention