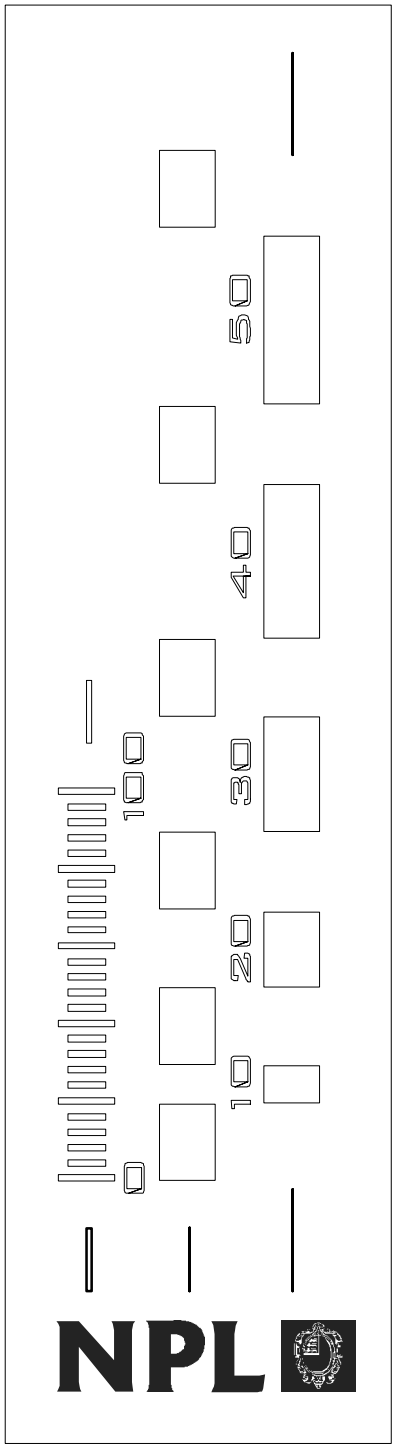
Solid State Sources:

How do we measure them ?

Christine Wall

2000



OVERVIEW

- What is a solid state source
- Why measure solid state sources
- NPL’s measurement set-up
- Presenting measurement results
- Conclusions
- Future work

WHAT IS A SOLID STATE SOURCE ?

Any electroluminescent material

(FED, LED, OLED, LEP…)

This talk concentrates on the measurement of Organic Light Emitting Diodes (OLEDs) used as displays.

WHY MEASURE OLED'S ?

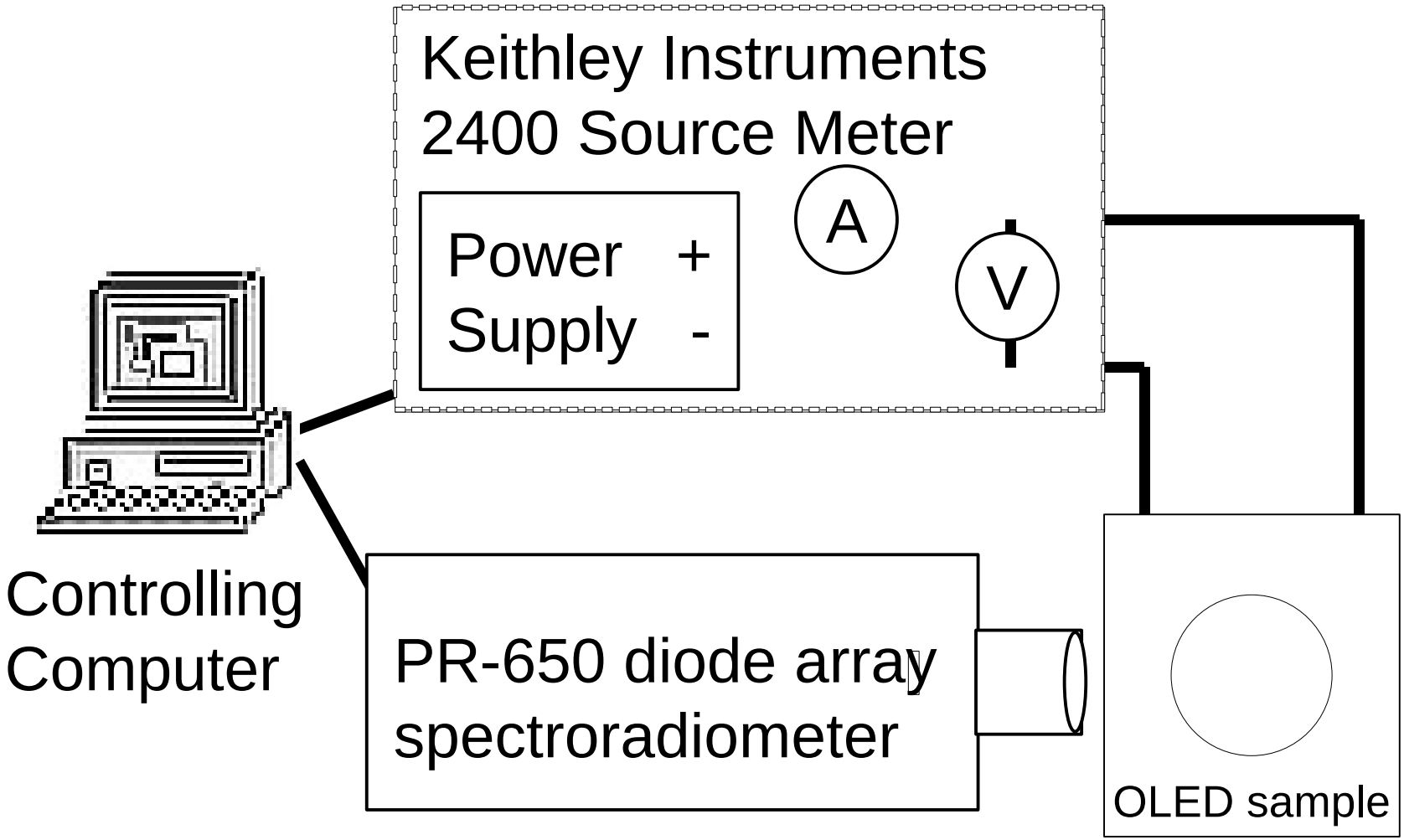
1. They are new and unproven
2. They are competing for existing markets
3. They must compete with existing technology
4. To evaluate device 'improvements'

NPL's MEASUREMENT SET UP

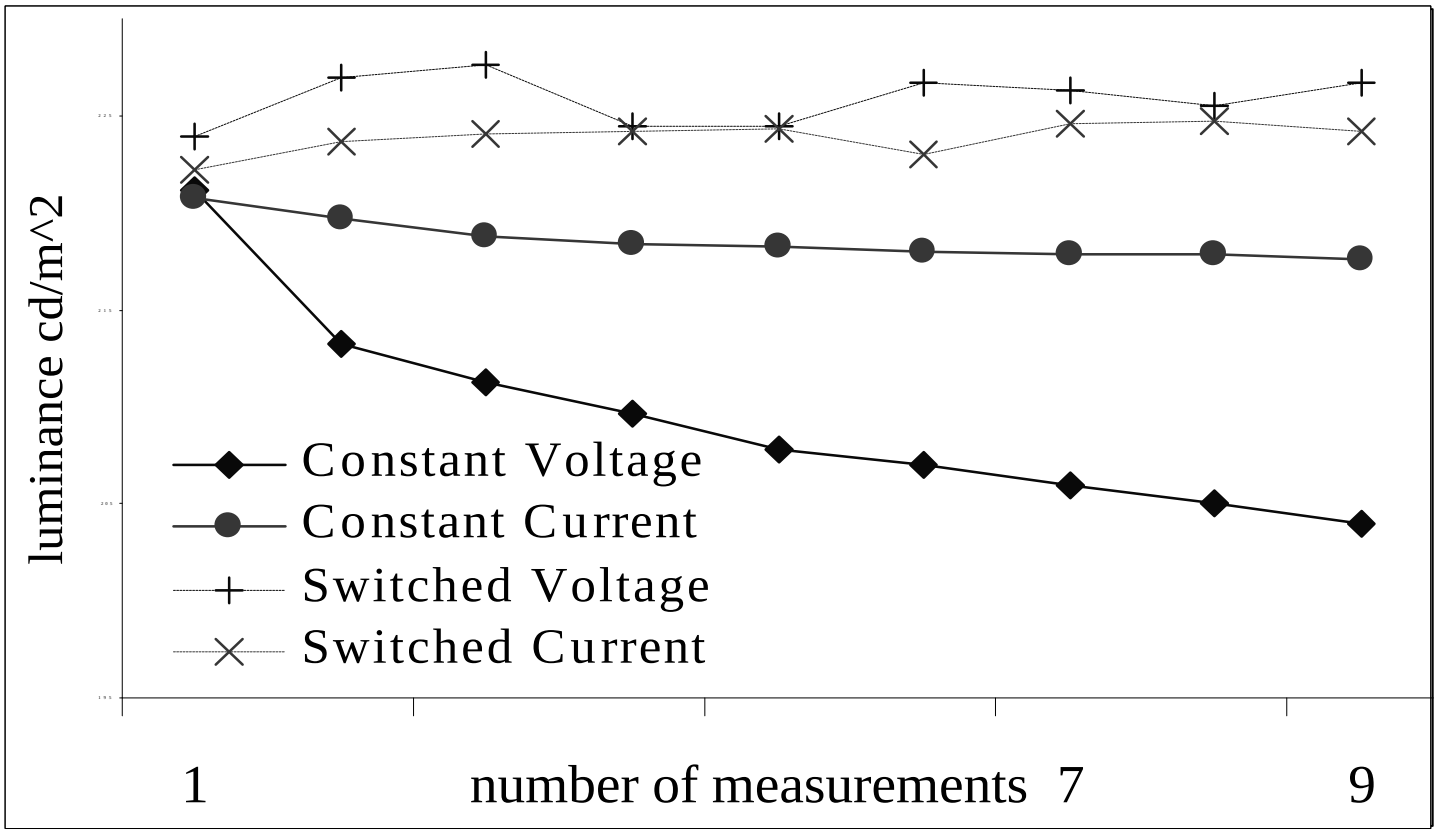
Industry & academia working with OLEDs require measurement of:

- Colour
- Luminance (continuous & pulsed operation)
- Device lifetime
- Identification of manufacturing weaknesses

NPL's MEASUREMENT SET UP

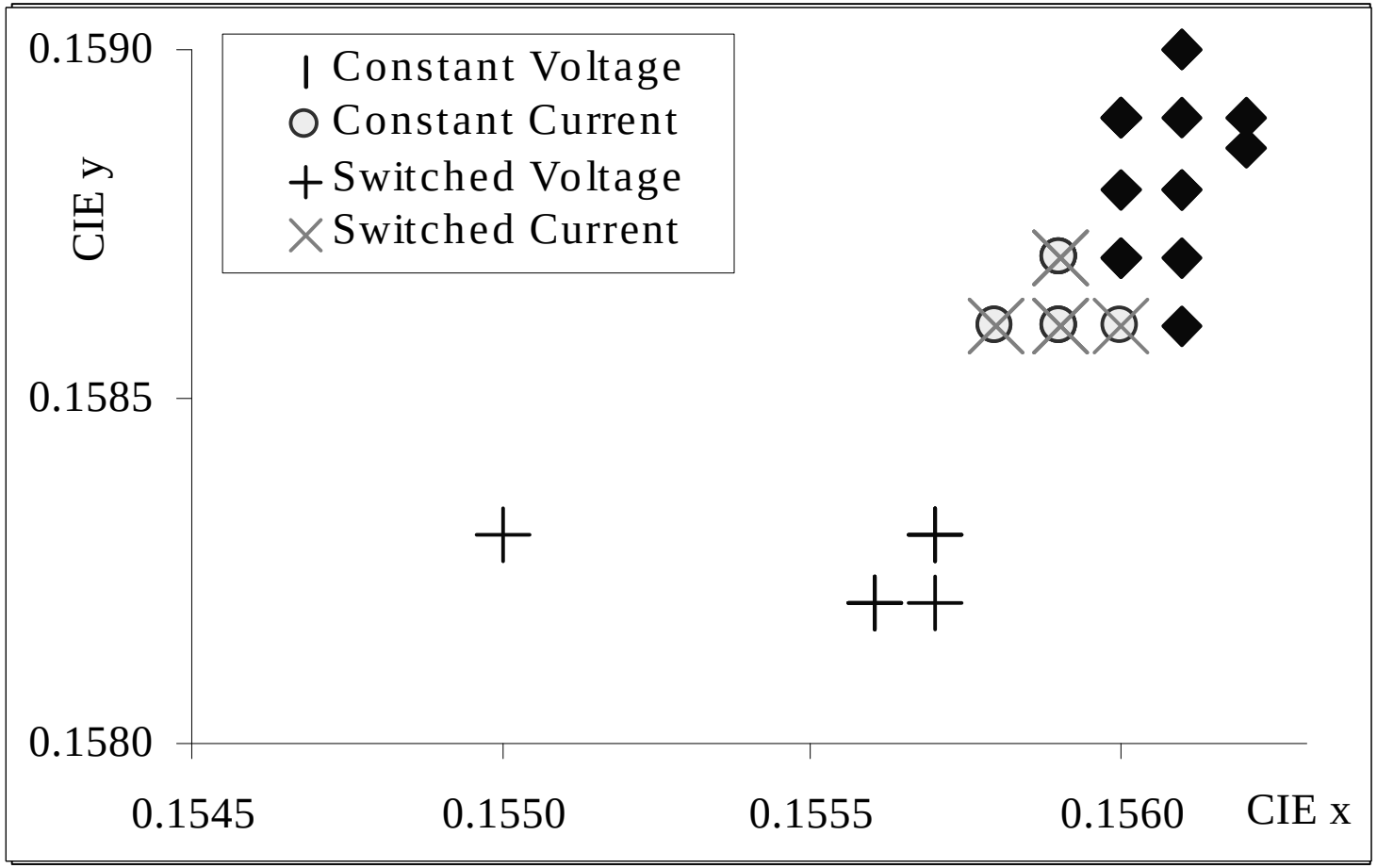


NPL's MEASUREMENT SET UP



Some OLEDs were traditionally driven under constant voltage. Test showed that current gives more consistent luminance and colour.

NPL's MEASUREMENT SET UP



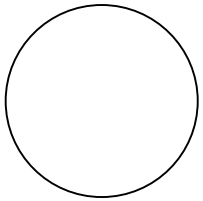
Colour repeatability between measurements

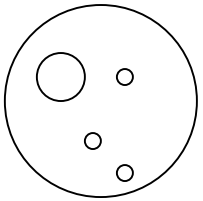
NPL's MEASUREMENT SET UP

Lifetime Measurements:

- Visual inspection
- Luminance deterioration with storage
- Luminance deterioration after temperature cycling

OLED deterioration is not well understood,dimming is seen also the appearance of dead zones on samples.





PRESENTING MEASUREMENT RESULTS

Conflicting ideals

Compare with existing technology

Show most useful information for OLEDs

PRESENTING MEASUREMENT RESULTS

Traditional LED	OLEDs for displays
Point source	Surface emitter
Non-Lambertian	Non-Lambertian
Lamp Measurement Method (Goniophotometer or Integrating sphere)	Displays Measurement Method (Telespectroradiometer)
Units = Lumens	Units = $\frac{\text{Candela}}{\text{Square metre}}$

PRESENTING MEASUREMENT RESULTS

Efficacy Measurements for OLED displays.

LEDs emit :

visible and invisible radiation

from a point, giving light in many directions

Therefore use efficacy in Lumens/Watt

OLEDs for displays emit:

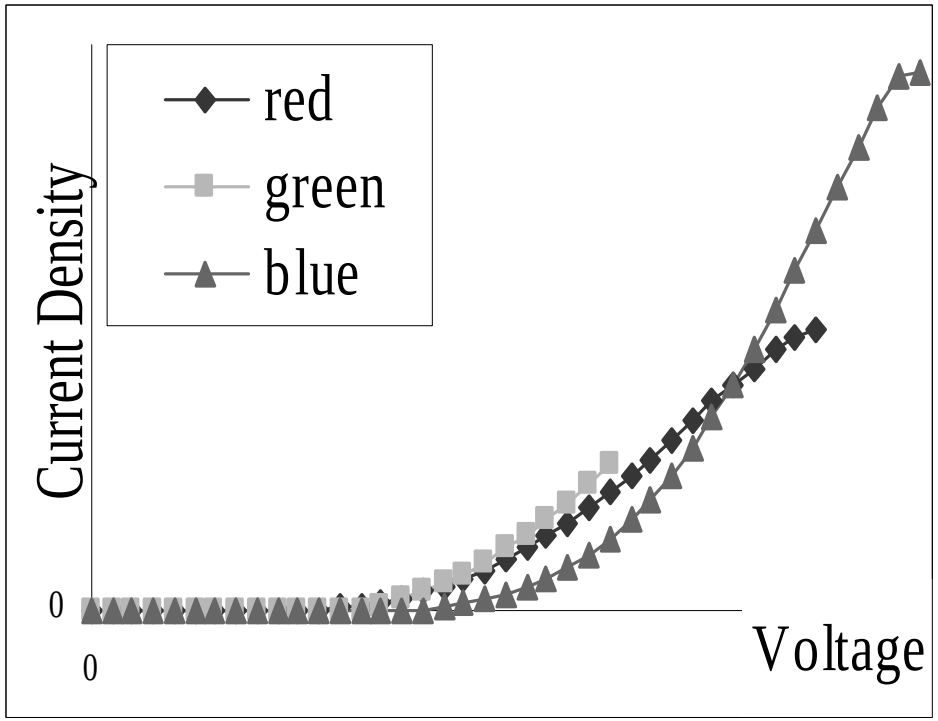
visible radiation

from a flat surface, into ~ 180 degrees

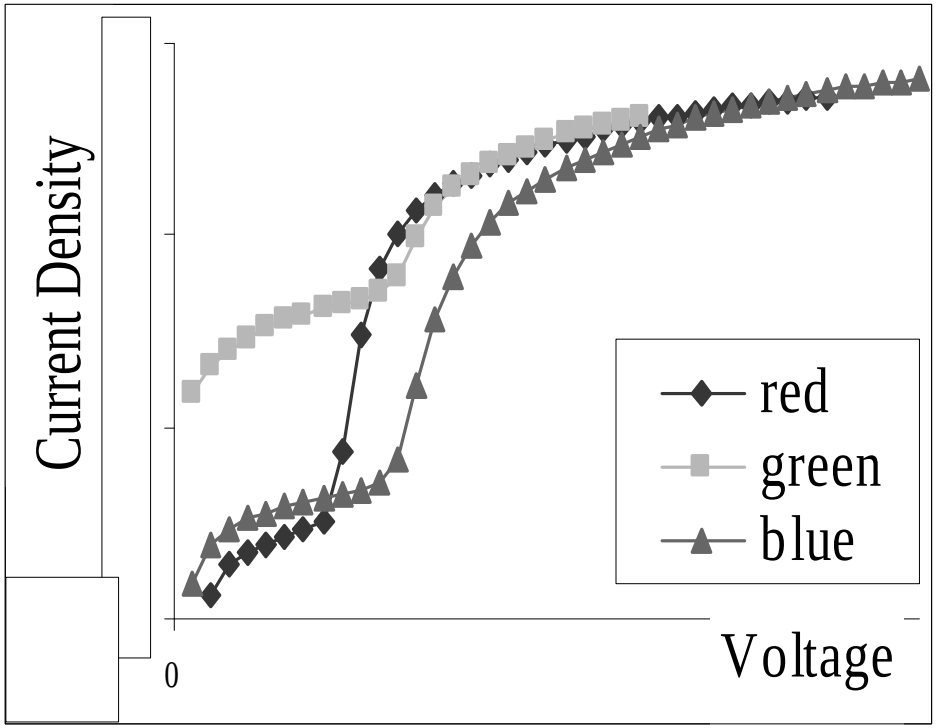
Therefore use efficacy in (Cd/m^2)/Watt

PRESENTING MEASUREMENT RESULTS

Linear or log scale



Linear scale



Logarithmic scale

CONCLUSIONS

- Drive cathodoluminescent OLED devices in constant current for maximum luminance and colour repeatability between measurements
- Use log scales to show maximum information
- Think carefully about all units used, particularly in efficacy measurements
- NPL has a system running for OLED characterisation (colour, luminance, electrical characteristics)

FUTURE WORK

- More work real samples
- Observations using digital camera to back up visual observations
- Lifetime definition and aging mechanisms
- Standardisation of all measurements

THANKS TO:

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