FlexPlay: A Micro-display on FlexTrate™

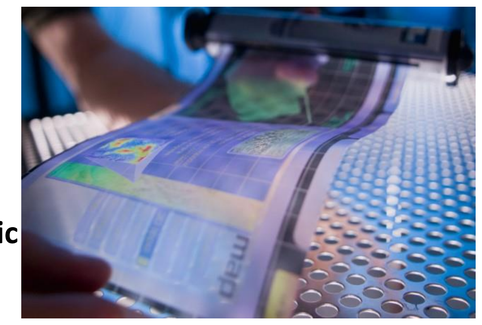
Henry Sun, Goutham Ezhilarasu, Guangqi Ouyang, Randall Irwin, and Subramanian S. Iyer

Center for Heterogeneous Integration and Performance Scaling (CHIPS)

Introduction

Motivation

- **In our Displays and Lighting sector, there has been growing interesting in inorganic microLED solutions integrated on flexible substrates**
  - **<100um x 100um size**
  - **<7 um thick**
- **They exhibit superior qualities over their organic counterparts:**
  - **Longer lifetimes**
  - **Stronger luminescence**
  - **High EQE**



Flexible Display for Military Applications [1]
https://www.army.mil/article/31123/army_to_display_flexible_technology

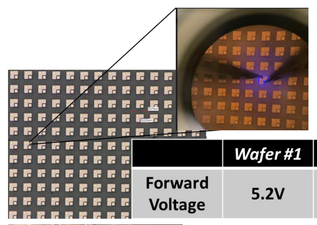
In our approach:

- **Transfer monochrome microLED arrays directly onto flexible substrate with pick and place tool**
- **Use quantum dot color conversion**
  - **Flexible electrically addressable LED pump plane (blue or UV) fabricated**
  - **Secondary three-color Quantum Dot layer to optically address RGB color conversion from pump plane**

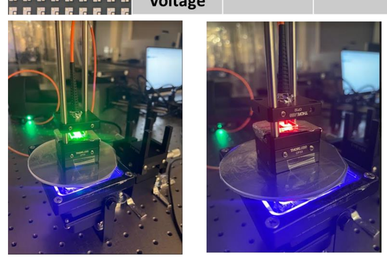
Milestones

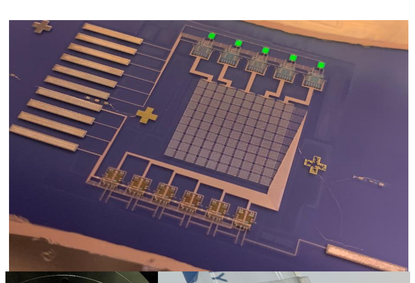
Milestones

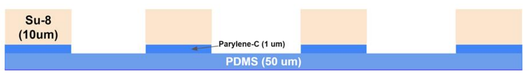
- **Fabricated custom, singulated 75um x 75um microLEDs from commercial GaN epitaxial wafers**
- **Characterized Green and Red quantum dot structures from Applied Materials**
- **Designed and demonstrated a passive matrix optical pump plane with the integration of microLED sapphire dielets**
- **Designed and fabricated a color conversion layer scaffold structure and process flow**

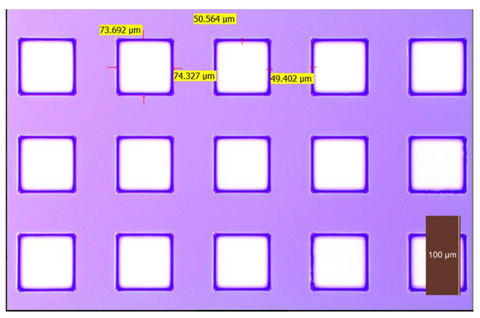


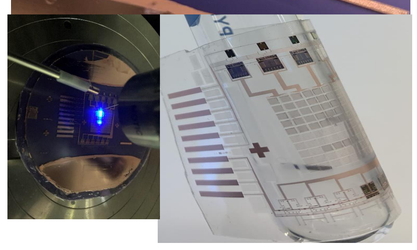
	Wafer #1	Wafer #2
Forward Voltage	5.2V	5.8V

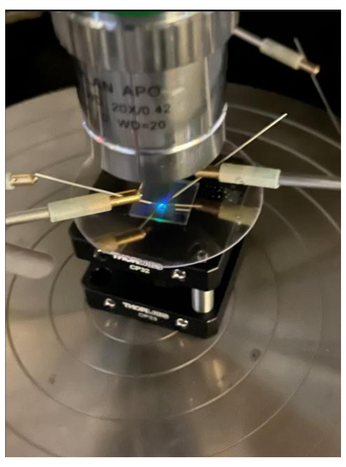




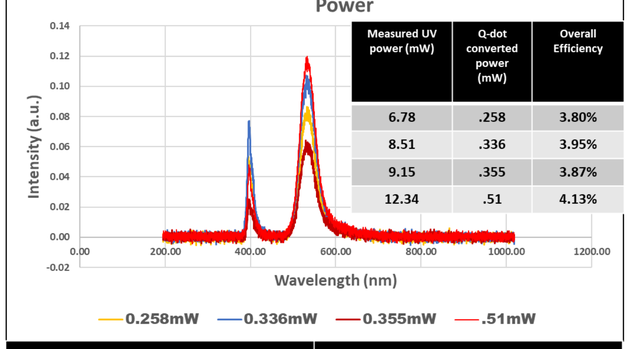






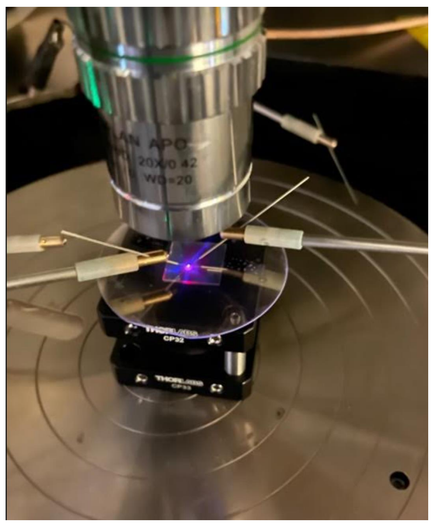


Green Q-dot Spectrum with relation to Optical Power

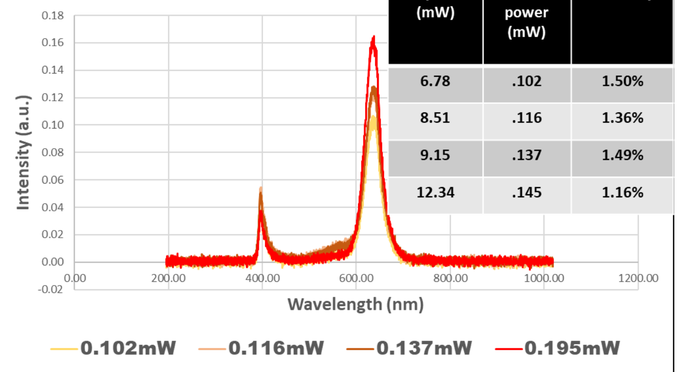


Measured UV power (mW)	Q-dot converted power (mW)	Overall Efficiency
6.78	.258	3.80%
8.51	.336	3.95%
9.15	.355	3.87%
12.34	.51	4.13%

Average Central wavelength (nm)	Average FWHM (nm)
532.75 ± 1.920	36.5125 ± 2.327



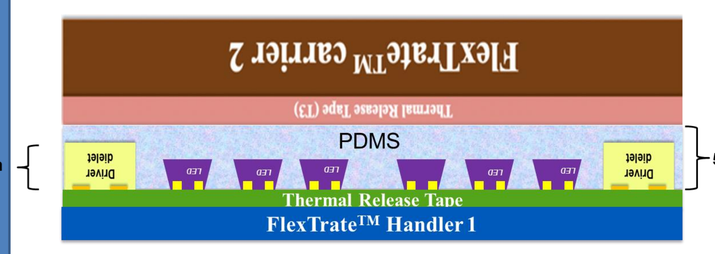
Red Q-dot Spectrum with relation to Optical Power



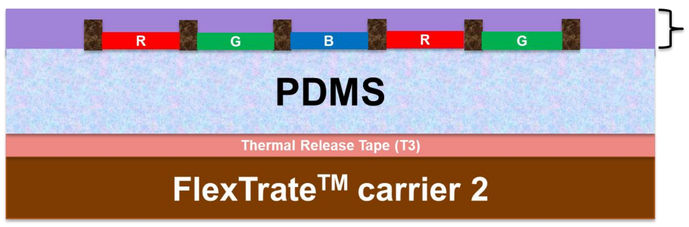
Measured UV power (mW)	Q-dot converted power (mW)	Overall Efficiency
6.78	.102	1.50%
8.51	.116	1.36%
9.15	.137	1.49%
12.34	.145	1.16%

Average Central wavelength (nm)	Average FWHM (nm)
635.005±0.597	32.79275±1.644

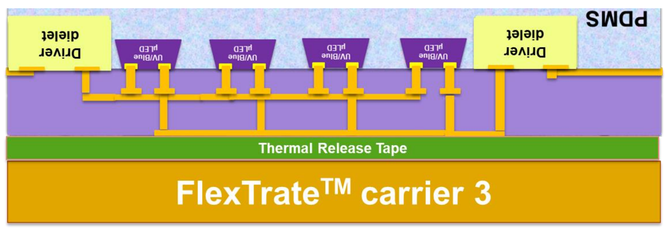
Process Flow



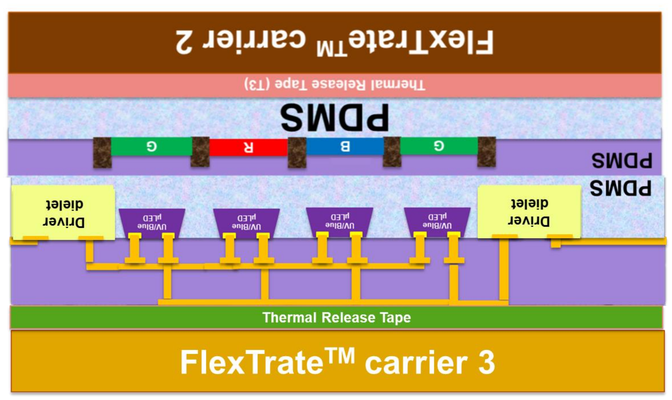
Mass transfer of monochrome microLEDs and encapsulate with PDMS for optical pump plane



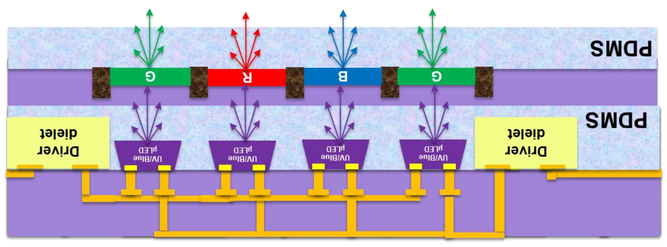
Color Conversion Layer created on a separate substrate



Transfer optical pump plane on another substrate



PDMS to PDMS bonding of the two substrates to integrate quantum dot color conversion



Release FlexTRATE handlers for final passive matrix display

Conclusion

- **Fabricated custom, singulated 75um x 75um microLEDs**
- **Verified feasibility of quantum dot color conversion on our PDMS substrate**
- **Demonstrated monochrome microLED passive matrix optical pump plane**

UCLA Samueli School of Engineering

2021 UCLA CHIPS Workshop
Poster Session

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