Materials and Device Designs for Printed Displays, Lighting & Energy

Professors: John A. Rogers, Placid Ferreira, Kent D. Choquette, Xiuling Li

Goals

Fabrication of inorganic optoelectronic devices using nano-CEMMS manufacturing system.

- Printable, microscale inorganic light emitting diode (LED) lighting elements.
- Passive/active-matrix micro-LED pixel arrays on low-cost, transparent, flexible, and/or stretchable substrates.

Research Results & Broader Impact

Epilayer design for printable LEDs

1. GaAs, 5 nm
2. Al0.45Ga0.55As:C, 800 nm
3. Al0.5In0.5P:Zn, 200 nm
4-12. Active region
13. Al0.5In0.5P:Si, 200 nm
14. Al0.45Ga0.55As:Si, 800 nm
15. GaAs:Si, 500 nm
16. Al0.96Ga0.04As, 1500 nm.
17. GaAs, 1500 nm
18. GaAs substrate
19. Gate/Anode

Flexible passive matrix display with transparency

Stretchable passive matrix display & Stretchable lighting system

Foldable lighting system

Interaction with Other Projects

Development of inorganic optical sources:
With Choquette and Li groups

Process integration platforms:
Transfer printing:
With Ferreira group

Future Efforts

Active matrix displays
Printable lasers

Testbeds and Applications

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Mapping to Center’s Objectives

Fabricate printable, micro/nanoscale, lighting elements.     Develop printing technologies for assembly on arbitrary substrates.     Manufacture lighting/display systems with superior mechanical and optical characteristics.

Fundamental Questions/Challenges

“Can micromanipulation strategies enable practical manufacturing of high-resolution, large-area inorganic lighting/display systems?”

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Research Plan

Build micro-LED lighting and passive matrix displays on low-cost, flexible, and/or stretchable substrates.

Fabricate printable micro-LED devices from epilayers on semiconductor wafers.

Develop reliable, scaleable micro-assembly technology based on nano-CEMMS transfer printing.

Manufacture high-resolution micro-LED lighting and displays: transparent, flexible, and/or stretchable.

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