Prof. Jeonghun Kwak Group

Advanced Opto & Nano Electronics Laboratory

http://aone.snu.ac.kr

Prof. Jeonghun Kwak

- Education
  - **B.S.** in Electrical Engineering, Seoul National University (2005)
  - **Ph.D.** in Electrical & Computer Engineering, Seoul National University (2010)
- Experience
  - 2010~2011 Post-doctoral Researcher, Seoul National University
  - 2011~2015 Assistance Professor, Dong-A University
  - 2015~2019 Assistance/Associate Professor, University of Seoul
  - 2019~present Assistance Professor, Seoul National University

Members

Fall 2019

- 13 Ph.D. Candidates
  - S. Rhee, H. Roh, J. Kim, Y. Ko, G.-W. Baek, T. Lee, K. Kim, Y. Park, S. Kim, E. Cho, J. Park, S. Lee, J. Kim (UoS)
- 3 M.S. Candidates in UoS
  - Y. Jeon, A. Hong, S. Hwang (KIST)

AONE Lab for Your Research

- **The best research facilities** in Display Center, ISRC, SNU.
- Several **research partners** from several companies, universities, and research institutes in Korea.
- **Projects** highly related to both journal papers and future job.

Most-Cited Papers

(Citation # from Google Scholar)

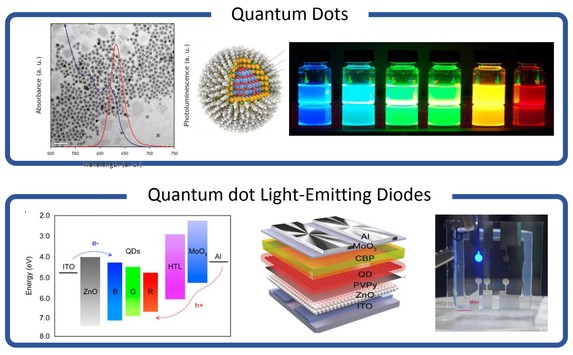
- Bright and efficient full-color colloidal quantum dot light-emitting diodes using an inverted device structure, *Nano Lett.* **12**, 2362 (2012) (577)
- Highly efficient green-light-emitting diodes based on CdSe@ ZnS quantum dots with a chemical-composition gradient, *Adv. Mater.* **21**, 1690 (2009) (211)
- Multicolored light-emitting diodes based on all-quantum-dot multilayer films using layer-by-layer assembly method, *Nano Lett.* **10**, 2368 (2010) (183)
- Silicon-Cored Anthracene Derivatives as Host Materials for Highly Efficient Blue

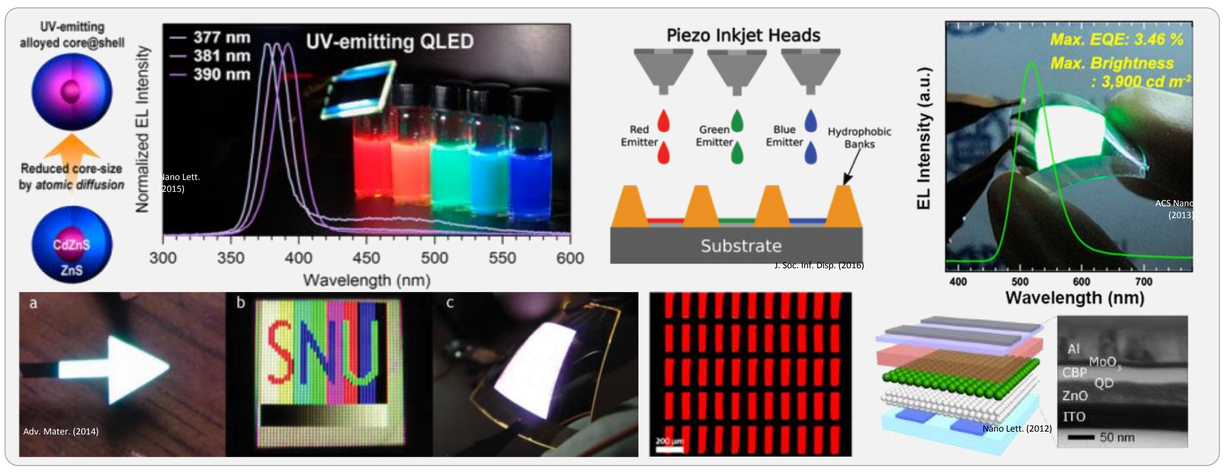
Position Open for You

- We welcome highly motivated students, who want to do research on opto & nanoelectronics, and to join the display companies & research institutes in the future.
- Email to Prof. J. Kwak (jkwak@snu.ac.kr).

Research Topic I. QLEDs

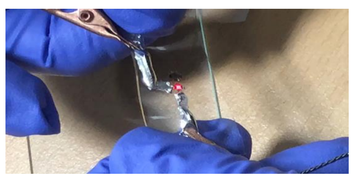
- What is QDs and QLED?
  - ***Quantum dot*** (QD) is a nanometer-sized semiconductor crystal.
  - QD's optical & electrical properties are descent for color emission.
  - ***QD based light-emitting diodes*** are the QLEDs, which are the most promising technology for the **future displays** with a wide color gamut.



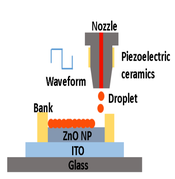


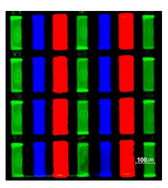
- We do research on …
  - Device structures, processes for higher performance QLEDs & Understanding QLED device physics
  - e.g., ***Flexible, stretchable, and transparent QLEDs, Cd-free QLEDs, inkjet printed QLEDs, and many other display applications***

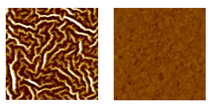
Now proceeding



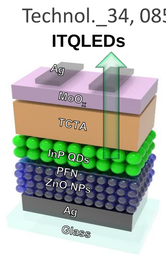
Stretchable QLED with transfer process

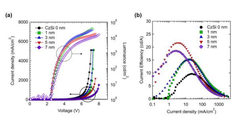




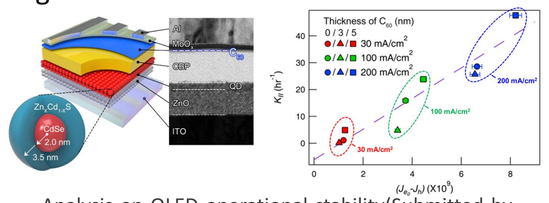


S. Lee et al, Semicond. Sci. Technol._34, 085002





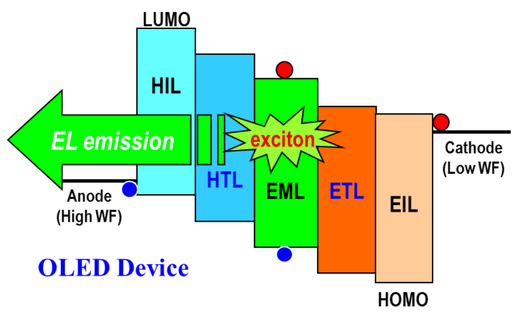
Record-high InP QLED



Analysis on QLED operational stability(Submitted by S. Rhee)

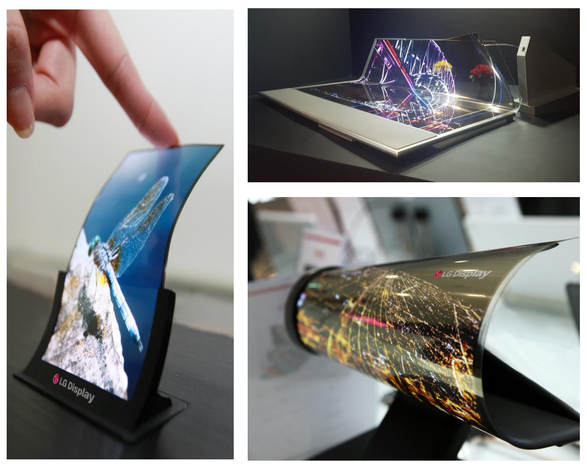
Research Topic II. OLEDs

- Organic Light-Emitting Diode



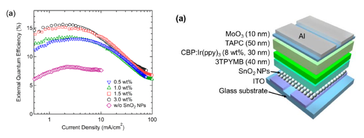
- ***Organic Light-Emitting Diode*** (OLED) is a light-emitting diode (LED) using the organic compound as the emissive electroluminescent layer.
- OLEDs are the most widely used technology in the present display industry for their outstanding characteristics such as ...

- Flexibility

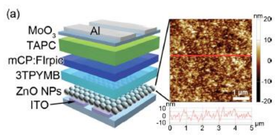


- Thickness control

- Recent research in AONE



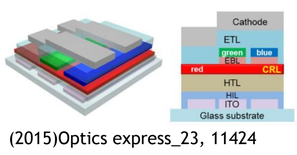
H. Lee et. al., *ACS Appl. Mater. Interfaces.*, **5**, 1977 (2013)

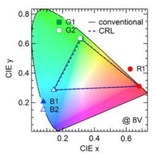


H. Lee et. al., *Appl. Phys. Lett.*, **96**. 153306 (2010)

– Transparent OLEDs

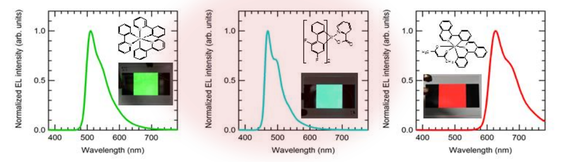
– Common layer for reducing patterning steps





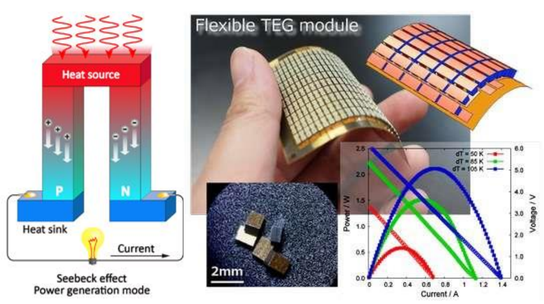
(2015)Optics express_23, 11424

R, G, B OLEDs –

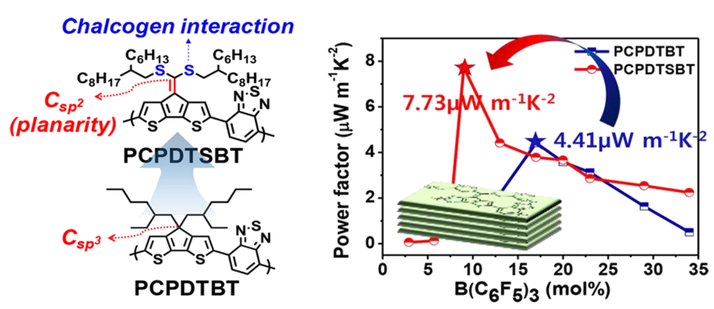


Research Topic III. Organic Thermoelectrics

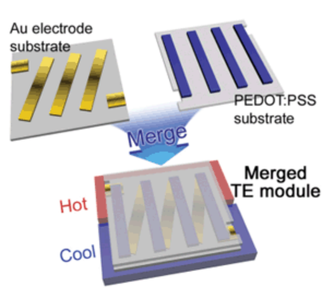
- What is thermoelectrics?

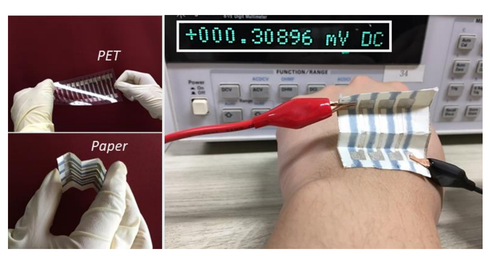


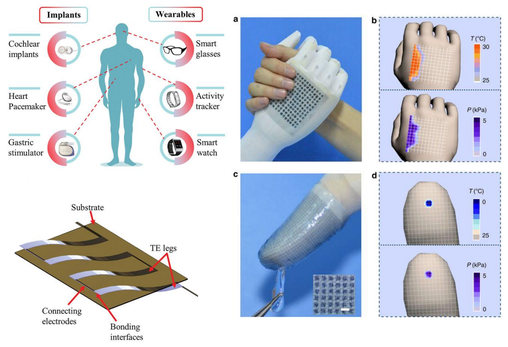
- Enhancement of organic TE performance



- Thermoelectric modules for generators



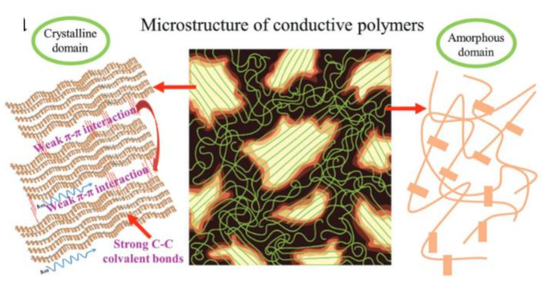


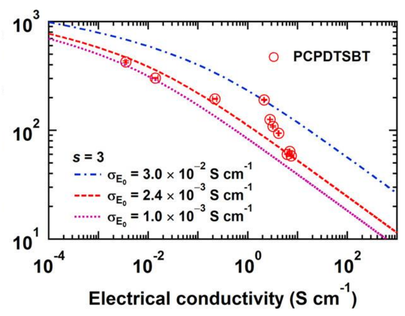


– ***Thermoelectrics*** (TE) is a physical phenomenon related to heat and electricity in solid-state materials.

- **We do research on …**
  - Development of high performance thermoelectric devices and generator modules in a flexible/stretchable substrates
  - Understanding the charge carrier transport mechanisms in organic molecules with simulation

- Analyzing transport mechanisms in organic semiconductors

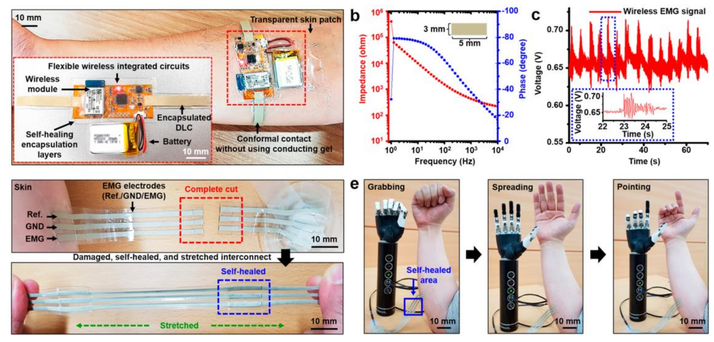




– ***Studying charge transport in organic semiconductors*** using the relationship between Seebeck coefficient and electrical conductivity.
– The ***latest*** transport model (i.e, ***Kang Snyder*** model) is used to analyze the ***organic semiconductors***.

- Thermoelectric modules for generators
  - ***Developing TE modules*** for generators and sensors using advanced technics like ***vacuum evaporation, spraying, inkjet printing***.
  - ***Stretchable TE device*** using various substrates like paper, PDMS, ***Ecoplex***.

- Stretchable conductors for multifunctional sensors



– Developing ***self-healable*** and ***ultra-stretchable conductors*** for ***human-robot interfaces***.
– High ***potential*** for multifunctional sensors (i.e, temperature, pressure)