ECE 693 Special Topic

Organic and Printed Electronics

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Course level: Graduate students

Pre-requisite: None

Lectures: TR 12:30 pm – 1:45 pm, room 2036, SERC

Office hours: TR 2:00 pm – 3:00 pm or per appointment

Course description

With an interdisciplinary nature, this course is designed to teach and prepare graduate students for the new era of organic and printed electronics. The objective is to provide students with a broad overview of organic electronic materials and devices with emphasis of research and practical applications. Topics covered on organic and flexible electronics include conjugated semiconducting materials, organic electronic & optoelectronic devices, such as thin-film transistors (OTFTs), light-emitting diodes (OLEDs), solar cells (OPV), etc., and technologies for high-speed printing on flexible substrates.

Topics to be covered (tentative, subject to change):

Part I: Organic Semiconducting Materials

1. Review of inorganic semiconductors and their properties
2. Brief review of organic chemistry
3. Conjugated small molecules and polymers
4. Electronic structure: hybridization of atomic orbitals, molecular orbitals
5. Molecular structure-process-property relationships

6. Characterization: UV-vis, Cyclic Voltammetry, XRD, etc.

Part II: Organic Electronic Devices

7. Review of PN junction diodes and MOSFETs
8. Thin-film transistors (OTFTs)
9. Light-emitting diodes (OLEDs)
10. Solar cells (include hybrid perovskite PV cells) (OPV)
11. Electrical measurement
12. Device stability

Part III: Flexible Electronics and High-Speed Printing

13. Organic devices on flexible substrate
14. Technologies of roll-to-roll printing
15. Stretchable electronics
16. Sintering of metal nanoparticles as contacts

Required textbook

No textbook required, lecture notes will be provided.

Reference book (on reserve in Rodgers Science & Engineering Library):

- Zhenan Bao and Jason Locklin, *Organic Field-Effect Transistors (Optical Science and Engineering),* CRC Press, 2007
- Ioannis Kymissis, *Organic Field-Effect Transistors: Theory, Fabrication and Characterization (Integrated Circuits and Systems),* Springer, 2009
- Qiquan Qiao (Editor)*, Organic Solar Cells: Materials, Devices, Interfaces, and Modeling (Devices, Circuits, and Systems),* CRC Press, 2015
- Christoph Brabec, Ullrich Scherf, Vladimir Dyakonov (Editors)*, Organic Photovoltaics: Materials, Device Physics, and Manufacturing Technologies*, Wiley-VCH, 2014
- Frederik C. Krebs, *Stability and Degradation of Organic and Polymer Solar Cells*, Wiley, 2012

- Hagen Klauk (Editor)*, Organic Electronics: Materials, Manufacturing, and Applications*, Wiley-VCH, 2006; *Organic Electronics II: More Materials and Applications*, Wiley-VCH, 2012
- Franky So (Editor), *Organic Electronics: Materials, Processing, Devices and Applications,* CRC Press, 2009
- Mario Pagliaro, *Flexible Solar Cells,* Wiley-VCH, 2008

Homework and exam policy

Homework discussion in small groups is encouraged. However, each student must work through each paper review and presentation individually. Pop quizzes are possible to maintain class attendance and participation.

Grading

Homework (regular and paper review) ……20%
Topic presentation 20%
Discussion and quiz ……10%
Midterm paper ……20%
Final exam ……..... 30%