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<td>Author(s)</td>
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<td>Citation</td>
<td>Fang, W. (2008, March). Work function engineering of electrodes via electropolymerization of ethylenedioxythiophenes and its derivatives. Presented at Discover URECA @ NTU poster exhibition and competition, Nanyang Technological University, Singapore.</td>
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<td>Date</td>
<td>2008</td>
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<td>URL</td>
<td><a href="http://hdl.handle.net/10220/8988">http://hdl.handle.net/10220/8988</a></td>
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Work Function Engineering of Electrodes via Electropolymerization of Ethylenedioxythiophenes and Its Derivatives

I. Introduction

- Fine-tuning the work function of the electrode is critical to enhance the carrier injection across semiconductor-electrode contact, improving the performance of devices.
- In this experiment, the work functions Au and indium-tin-oxide (ITO) can be modified by surface-electropolymerization using ethylenedioxythiophenes (EDOT) or its derivatives. The resulting work function is tunable by varying the electropolymerization condition. Furthermore, the diode devices with EDOT-COOH modified on ITO surface demonstrate the possibility of improving contact property in organic electronics.

II. Experiment, Results and Discussion

- With longer electropolymerization time, it was observed that the grain size increased and the morphology became very different for both polymers.
- When thicker films were deposited after electropolymerization for a longer period of time, the values of work function are determined by the composition of polymer films regardless the electrode materials underneath.

Figure 2. AFM images for (a) plain Au, and those electropolymerized with (b) 5 sec (c) 10 sec and (d) 40sec of EDOT-COOH monomer. AFM images for those electropolymerized with (e) 5 sec (f) 10 sec and (g) 40sec of EDOT-OH monomer.

Figure 3. (a) Chemical structures of EDOT, EDOT-OH and EDOT-COOH (b) Measured work function for sputtered Au and ITO electrodes electropolymerized with EDOT, EDOT-OH and EDOT-COOH as a function of electropolymerization time.

Figure 4.(a) Current density of the diodes with the structure of Au(thermal evaporated 100nm)/Pentacene(50nm)/PEDOT-COOH/ITO. Inset shows the schematic illustration of the devices. (b) The current density of the diodes driven by different voltages as a function of electropolymerization time on ITO electrodes.

III. Conclusion

- The work function of Au and ITO can be tuned continually by electropolymerization using EDOT, EDOT-COOH and EDOT-OH. This method is controllable and suitable for wide-range selections of electrodes.

IV. Acknowledgment

- The author wishes to thank NTU for the funding of the project. The author also wishes to thank Assistant Professor Li Lain-Jong, Shi Yumeng for their consistent guiding and help throughout the project.

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