A MULTIDISCIPLINARY POLYMER ELECTRONICS LABORATORY

David Braun[1] Kevin Kingsbury[2], and Linda Vanasupa[3]

Abstract *- Semiconducting polymers blend several attractive features that enable inexpensive and unique applications. Forming the subjects of numerous research and development projects, semiconducting polymers also make excellent teaching tools. Since the materials and their applications benefit from intrinsically multidisciplinary approaches, polymer electronics exposes both students and faculty to fruitful interdisciplinary collaboration. This presentation introduces semiconducting polymers, tours the Cal Poly polymer electronics lab facility, and summarizes lab projects and course modules completed to date.*

Cal Poly has established a polymer electronics laboratory to advance how engineering and science students learn about semiconductor devices and materials. Polymer electronics based on semiconducting polymers currently attracts widespread attention as the subject of numerous research and development projects. Semiconducting polymers are also excellent materials with which to teach a wide range of undergraduate engineering topics extending from the macroscopic to microscopic. For example, systems engineering of displays and image sensors based on semiconducting polymers involves applications which teach students concepts such as structure-property relationships, polymer synthesis, polymer film preparation, optical and electronic properties, semiconductor device fabrication principles, and device testing.

Polymer electronics encourages student participation in educational activities that bridge several disciplines. Polymer electronics improves student learning by making normally obscure semiconductor concepts more tangible for students in several disciplines: Chemistry students create electronics applications for the compounds they synthesize, materials engineering students learn about opto-electronics techniques, and electrical engineering students gain hands-on experience with core concepts in semiconductor devices.

This presentation describes the interdisciplinary projects that students and faculty have completed thus far, particularly during the phase of lab design and construction. The presentation includes a summary of course modules and student projects implemented to date.

Using a polymer light-emitting diode [LED] as an example illustrates several nice features of polymer electronics as a multidisciplinary instructional vehicle. A polymer LED consists essentially of a plastic sandwich. Figure 1 illustrates the device geometry. Applying a positive voltage to the anode relative to the cathode causes current to flow through the polymer film and light emission from the polymer film through the transparent bottom electrode and substrate.

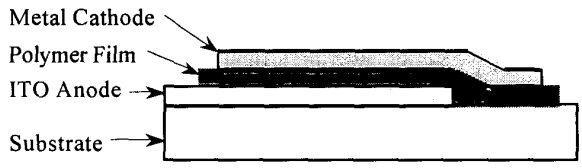

Figure 1. Polymer LED Geometry

The photo in Figure 2 shows where each of the following steps in the fabrication sequence takes place.

1) Clean substrates in ultrasonic bath (not shown).
2) Clean substrates in dust free work area.
3) Transfer substrates into glove box.
4) Spin coat polymer film.
5) Transfer parts into glove box.
6) Coat top metal electrodes in vacuum evaporator.
7) Test polymer LEDs.

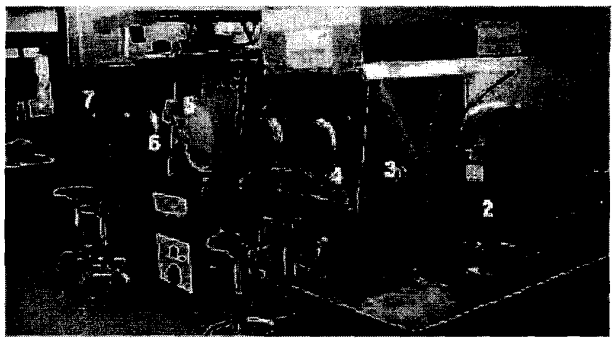

Figure 2. Polymer Electronics Laboratory

More information about semiconducting polymers and course modules is available via the lab web site: http://www.ee.calpoly.edu/~dbraun/polyelec/.

This material is based upon work supported by the National Science Foundation under Grants No. 9702320 and 9820781 and the Cal Poly Plan Project

[1] Electrical Engineering Department; Cal Poly State University, San Luis Obispo, California, 93407
[2] Department of Chemistry and Biochemistry, Cal Poly State University, San Luis Obispo, California, 93407
[3] Materials Engineering Department; Cal Poly State University, San Luis Obispo, California, 93407

0-7803-6424-4/00/$10.00 © 2000 IEEE