Diploma works at the department of Printed Electronics at Acreo, Norrköping

1. Design of an addressing electronic circuit for printed matrix-addressed electrochromic displays

The department of Printed Electronics at Acreo and the group of Organic Electronics at Linköping University are developing a printable display technology relying on the electrochemical switching of solution-processed conjugated polymers. Active matrix addressed displays are achieved by combining the color switch in electrochromic pixels and the conductivity switching in electrochemical transistors, while passive-matrix displays solely are using a cross-point matrix of electrochromic pixels.

The diploma work is primarily aiming at the development of an appropriate external addressing electronic circuit to be used in combination with printed matrix-addressed electrochromic displays. In addition to the electronic circuit design of the addressing circuit, understanding of the physics and chemistry that govern the operation of electrochemical devices along with the printing techniques used for manufacturing the displays will be obtained, which promises for a cross-disciplinary and interesting diploma work.

The diploma work could consist of:

- a literature study including an evaluation of various addressing protocols for matrix-addressed electrochromic displays
- the electronic circuit design of the most adequate addressing protocol
- hardware implementation into display demonstrator
- summarizing the work in a diploma work thesis

Suitable for undergraduate students in: Y, ED or similar M. Sc. programs

Extension: 20 weeks (30 HE credits)

Location: Acreo, Norrköping

Contact: Peter Andersson Ersman, peter.andersson.ersman@acreo.se, 011-202507

2. Evaluation of commercially available chip solutions for hybrid printed electronic systems

The department of Printed Electronics at Acreo is developing printed electrochromic displays. Only a battery is required to drive the display in the simplest applications. However, in more advanced applications there are requirements to integrate the display with an integrated circuit responsible for addressing the display segments.

The diploma work is primarily aiming at the understanding of the availability of chip solutions suitable for addressing of a printed electrochromic display system. The display can, for example, have the shape of a digit containing 7 or 14 segments. In addition to the literature study, with the purpose to find appropriate integrated circuits, the diploma work will also contain chip programming, integration of chip and display and evaluation of the resulting system.

The diploma work could consist of:

- a literature study summarizing appropriate and available chip solutions suitable for display addressing
- chip programming and integration of chip and display
- hardware implementation into display demonstrator
- summarizing the work in a diploma work thesis

Suitable for undergraduate students in: Y, ED or similar M. Sc. programs

Extension: 20 weeks (30 HE credits)

Location: Acreo, Norrköping

Contact: Peter Andersson Ersman, peter.andersson.ersman@acreo.se, 011-202507

3. Evaluation of printed decoder to minimize the number of chip contact pads in hybrid electronic systems

The department of Printed Electronics at Acreo is developing printed electronic systems. Only a battery is required to drive an electrochromic display in the simplest applications. However, in more advanced applications there are requirements to integrate the display with an integrated circuit responsible for addressing the display segments. In order to minimize the number of contact pads on the integrated chip a printed decoder between the chip and the electrochromic display is needed. The diploma work is primarily aiming at designing and testing possible decoder system. The decoder will be built up by electrochemical transistors that will be printed at Acreo.

Another feasible electronic system design would be to have printed sensors generating the input signals to a decoder consisting of printed transistors. Such diploma work would therefore take care of the interface between the sensors and the chip.

The diploma work could consist of:

- a literature study to collect background information regarding electrochemical devices
- design of the decoder
- manufacturing of the prototypes
- characterization of the decoder
- the interface between the chip and the display, and/or
- the interface between the sensors and the chip
- summarizing the work in a diploma work thesis

Suitable for undergraduate students in: Y, ED or similar M. Sc. programs

Extension: 20 weeks (30 HE credits)

Location: Acreo, Norrköping

Contact: David Nilsson, david.nilsson@acreo.se, 011-202530

4. Biosensors

The department of Printed Electronics at Acreo develop printed electronic devices. A future target is to develop single-use sensor systems, for point of care applications, in which we combine sensors with printed logics, batteries and displays.

This diploma work aims at the development of printed biosensors. By biosensors we mean a sensor, with a biological sensor element that generates an electronic output signal upon interaction with a specific analyte. One example of such sensor is a glucose sensor, used in diabetes care. Many biosensors exist today, but only a few of them are printable.

The diploma work will include the following activities:

- selection of one or more sensors to be printed
- literature study of printing technologies and printed sensors
- learning how to use printing equipment (in Acreos lab)
- design and realization of printed sensors
- characterization and evaluation

Suitable for undergraduate students in: Y, ED, TB or similar M. Sc. programs

Extension: 20 weeks (30 HE credits)

Location: Acreo, Norrköping

Contact: Petronella Norberg, petronella.norberg@acreo.se, 011-202520 or David Nilsson david.nilsson@acreo.se, 011-202530

5. NMR proton mobility measurements of novel organic FET gate dielectrica

Gating the transistor channel in an organic electrolyte gated field effect transistor (EGOFET) by polyacid has led to low voltage gating. In this diploma work, proton mobility by NMR techniques of novel polyacid gate media is to be characterized and correlated to results from impedance spectroscopy.

Access to appropriate NMR equipment and an examinator experienced in NMR techniques is necessary.

The diploma work will consist of:

- A literature study of methods for NMR methods to determine proton mobility and selection of NMR experiment
- Sample preparations, NMR measurements and impedance spectroscopy
- Summarizing the work in a diploma work thesis

Suitable for undergraduate students in organic-, polymer- or materials chemistry or physics

Extension: 20 weeks (30 HE credits)

Location: University department and Acreo AB, Norrköping

Contact: mats.sandberg@acreo.se

6. ESR study of the electrode reactions at the PEDOT:PSSH – electrolyte interfaces

Poly(3,4-ethylenedioxythiophene) : poly(styrenesulfonic acid) (PEDOT:PSSH) has become an important material in organic electronics, and it is often used as electrode in electrochemical devices. However, little is known about the details of the electrode reactions at PEDOT:PSSH in water electrolysis. Here, electrochemical cells are to be manufactured that can be placed in an ESR cavity so that unpaired species in the anode and cathode reactions can be followed separately.

The diploma work will consist of:

- Preparation of printed flexible electrochemical cells fitting into an ESR cavity
- Characterization of radical species in cathode and anode reactions
- Summarizing the work in a diploma work thesis

Suitable for undergraduate students in organic, materials chemistry or physics

Extension: 20 weeks (30 HE credits)

Location: University department and Acreo AB, Norrköping

Contact: mats.sandberg@acreo.se

7. FTIR ATR study of the electrode reactions at the PEDOT:PSSH – electrolyte interfaces

Poly(3,4-ethylenedioxythiophene) : poly(styrenesulfonic acid) (PEDOT:PSSH) has become an important material in organic electronics, and it is often used as electrode in electrochemical devices. However, little is known about the details of the electrode reactions at PEDOT:PSSH in water electrolysis. Here, electrochemical reactions are to be followed by Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy. Electrochemical cells are to be manufactured that can be placed on top of an ATR crystal with the aim of tracing species or their trapping products at the electrode - electrolyte interface spectroscopically. An FTIR with ATR accessory is provided at Acreos lab facility in Norrköping.

The diploma work will consist of:

- Preparation of printed flexible electrochemical cells that can be placed on an ATR crystal
- Characterization of electrode and electrolyte by ATR-FTIR
- Summarizing the work in a diploma work thesis

Suitable for undergraduate students in organic, materials chemistry or physics

Extension: 20 weeks (30 HE credits)

Location: Acreo AB, Norrköping

Contact: mats.sandberg@acreo.se

8. Irreversible effects in electrochromic devices

Irreversible effects can be both detrimental for certain display applications and interesting for other applications. This diploma work is to survey known irreversible effects in electrochromic materials, as well as exploring possibilities of practical utilization. The work should aim for devices that are fully printable and not requiring the use of conducting metal oxides as transparent collectors.

The diploma work will consist of:

- A literature study of irreversible electrochromic reactions
- Manufacturing of electrochemical cells
- Characterization of irreversible effects in electrochromic cells

Suitable for undergraduate students in organic-, polymer- or materials chemistry

Extension: 20 weeks (30 HE credits)

Location: Acreo AB, Norrköping

Contact: mats.sandberg@acreo.se

9. Improved UV-curing of printed electronics materials

Printing is the lowest cost method for selective deposition of materials. The economy of printing is typically limted by the slowest process step, typically the curing of one ink before the next layer can be desposited. Shorter curing times are desirable for cost reasons, but efficiency of the curing is also important for device stability. In this study, thiol-ene chemistry is to be explored as a method to improve curing in printed compositions based on acrylates and methacrylates. Curing efficiency is to be followed using Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy, and the influence of curing of device properties is to be followed electronically.

The diploma work will consist of:

- Preparation of printable compositions that can be UV-cured with a thiol-ene mechanism

- Characterization of the curing behavior by ATR-FTIR
- Summarizing the work in a diploma work thesis

Suitable for undergraduate students in organic-, polymer- or materials chemistry

Extension: 20 weeks (30 HE credits)

Location: Acreo AB, Norrköping

Contact: mats.sandberg@acreo.se