SYOE 5: Organic Devices

Time: Tuesday 11:15–12:45 Location: H1

Invited Talk SYOE 5.1 Tue 11:15 H1

Organic electronic devices and their applications — •Paul Heremans — IMEC, Leuven, Belgium

Organic electronics will be enabled not only by thin film transistors, but also by such devices as memory and diodes.

In this presentation, we will focus on devices that can enable RFID applications or other autonomous sensor tags. Such applications require in particular transistor circuits operating at low voltage. Several strategies could be followed to achieve this, and we will provide a comparison between the performance and limitations that can be expected by complementary logic versus ambipolar logic. A second device needed for RFID applications is a diode for high frequency rectification. We will start by outlining the specifications required for these diodes. Then, we will show the state of the art of the performance that has been achieved to this date by diodes made using, on the one hand, transistors with the drain shorted to the gate, and, on the other hand, "Schottky" diodes with a rectifying metal contact. Finally, results of practical organic RFID tags using Schottky diodes will be shown.

SYOE 5.2 Tue 12:00 H1

Ambipolar transport and light emission in polymer field-effect transistors in top gate geometry — •Jana Zaumseil, Carrie Donley, Ji-Seon Kim, Chistopher McNeill, Richard Friend, and Henning Sirringhaus — Cavendish Laboratory, Cambridge University, JJ Thomson Avenue, Cambridge CB3 0HE, United Kingdom

We have recently demonstrated that ambipolar charge transport is a generic feature of a wide range of polymer field-effect transistors (FETs) when appropriate injecting electrodes and trap-free dielectrics are used. An intriguing feature of ambipolar FETs with simultaneous hole and electron accumulation is the radiative recombination of opposite charge carriers within the channel, and thus light emission. Here we demonstrate ambipolar light-emitting FETs based on electroluminescent conjugated polymers in bottom contact/top gate geometry using gold electrodes and polymer gate dielectrics. We observe light emission from a narrow recombination zone whose position is controlled by the applied gate and source-drain voltages and depends on the ratio of hole to electron mobility and contact resistance. The light output is proportional to the drain current with quantum efficiencies comparable to those of polymer LEDs despite very high current densities. Width and intensity distribution of the emission zone were found to depend strongly on the microstructure of the polymer film. Light-emitting FETs thus allow insight into the transport properties of organic field-effect transistors that are not obvious from current-voltage characteristics alone.

SYOE 5.3 Tue 12:15 H1

Electrical characteristics of Ferroelectric Field Effect Transistors (FeFETs) incorporating Langmuir-Blodgett films — •Hermann Kohlstedt[1], Anderas Gerber[4], Rainer Waser[1], Timothy Reece[2], Stephen Ducharme[2], Eduard Rije[3], Martin Roeckerrath[3], and Jürgen Schubert[3] — [1]Institute of Solid State Research (IFF), and CNI * Center of Nanoelectronic Systems for Information Technology, 52425 Jülich, Research Center Jülich, Germany — [2]Nebraska Center for Materials and Nanoscience, — [3]Institute for Bio and Nanosystems (IBN1), and CNI * Center of Nanoelectronic Systems for Information Technology, 52425 Jülich, Research Center Jülich, Germany — [4]Smart Materials, Caesar Research Center, 53175 Bonn, Germany

We report the electrical characteristics of a kind of non-volatile memory device consisting of a field-effect transistor where the gate insulator includes a thin ferroelectric polymer film, producing a Ferroelectric-FET, or FeFET. Each device consisted of a p-type silicon substrate, with diffusion-doped source and drain contacts, SiO2, HfO2, CeO2 or DyScO3 as dielectric buffer layer, a ferroelectric Langmuir-Blodgett film of a 70% vinylidene fluoride-30% trifluoroethylene copolymer, and a gold gate electrode. Details of the fabrication procedure will be presented. The source-drain conductance showed hysteresis due to polarization reversal in the ferroelectric film as the gate bias voltage was cycled. State retention was approximately several minutes. The FeFET is a promising low-voltage and nonvolatile memory element that affords fast non-destructive readout.

SYOE 5.4 Tue 12:30 H1

Current injection and contacts to Cu(TCNQ) — •Artur Hefczyc, Lars Beckmann, Eike Becker, Hans-Hermann Johannes, and Wolfgang Kowalsky — Institut für Hochfrequenztechnik, Technische Universität Braunschweig, Braunschweig, Germany

The development of organic electronics has caused increasing interest in non-volatile organic memories. Although many groups have reported memory effects in a wide range of material systems, the details of the switching mechanism are still not known. We have investigated the influence of contacts in devices based on the Cu(TCNQ) charge transfer complex by using combinations of different metals as well as metals and oxides. Our results show that the configuration of the contacts as well as the details of current injection have a crucial influence on device properties, e.g. on the polarity of the voltages required for switching. We report on the experimental results and the conclusions that can be drawn for the physics of the switching mechanism.