Poster Session 2

Commons East, Easel 70

1:00 PM to 2:30 PM

An Organic Electrochemical Transistor with a Novel Double-in-Plane Gate Electrode

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Mentor: Seungkeun Choi, STEM

PEDOT:PSS-based organic electrochemical transistor (OECT) has been widely used for various sensing applications such as glucose, antigen, DNA, and pH sensing thanks to the much lower working voltages, typically less than 1 V, and known biocompatibility of a PEDOT:PSS. OECT comprises three electrodes (source, drain, and gate), a PEDOT:PSS channel between source and drain, and electrolyte solution of analytes. Electric current flows through the conductive PEDOT:PSS channel. However, upon the application of a positive gate voltage, cations from the electrolyte are injected into the channel, decreasing a conductivity of the PEDOT:PSS. Hence, electric current decreases as a gate voltage becomes more positive. In general, OECT is implemented by submerging a separate gate electrode in an electrolyte solution, thereby, making this only suitable for a laboratory environment. However, reports dealing with the impact of in-plane gate electrode on the OECT performance are relatively scarce. The proposed double-in-plane gate electrode for OECTs possesses great potential for the development of highly integrated OECT where each transistor can be separately controlled from its own gate electrode. All electrodes (gate, source, and drain) were placed in the same plane. High conductivity PEDOT:PSS was used to create a channel between source and drain. A PBS (Phosphate-Buffered Saline) was used as an electrolyte and pH value was adjusted with a hydrochloric acid. A drop of electrolyte of pH 3, 4, 5 or, 7.4 was placed just over the channel and the gate electrode. Compared to the transistor with a single gate, the double-gate transistor exhibited much higher transconductance of 35 mS. This means that the double-gate transistor can modulate larger current at the same gate voltage. Such a high transconductance with in-plane architecture will allow the development of portable OECT arrays for various chemical/biological sensing applications.

Poster Session 2

Commons East, Easel 69

1:00 PM to 2:30 PM

A Multilevel Resistive Memory Device Based on Molybdenum Oxide

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There has been expanding research into Resistive Random Access Memory (ReRAM) in order to replace conventional flash memory due to its lower programming voltage and faster read/write speed. In a ReRAM device, information is stored in a varying resistor whose resistance value can stay longer without an external power supply, hence making this as a good nonvolatile memory device. The resistance value can be changed by applying set/reset voltages and read by applying very small voltages. Furthermore, a ReRAM can be highly dense by implementing a cross-point array structure to store information. Recently, there has been great interest in a multilevel ReRAM in which one memory cell can have many different resistance states. This means that one memory cell can store more than one bit of digital information, i.e., ones and zeros; hence, enabling high density and miniaturization memory cell implementation. The ReRAM device that we have fabricated has a three-layered structure. The bottom electrode is a 150 nm layer of Indium-Tin- Oxide (ITO) and a 10 nm thick active layer molybdenum oxide was deposited by thermal evaporation. Finally, the top electrode of Ag (150nm) was deposited through a shadow mask by thermal evaporation. Current-Voltage (I-V) curve was measured by applying voltage between top and bottom electrode. The voltage was incremented from -2 to 2 Volts with 5 mV steps. A compliance current, or limiting current, was set to avoid breakdown due to the large current flow. The device exhibited 4 different resistance states by sweeping the device with different compliance current (10μA, 1mA, 10mA, and 100mA). Once the resistance states were set to a new value, original resistance values would not be restored. The irreversible characteristic of this device makes it suitable for many applications that need Write-Once-Read-Many (WORM) memory technology such as BIOS for computer and portable electronics.