Bilayer Processing for an Enhanced Organic-Electrode Contact in Ultrathin Bottom Contact Organic Transistors

Tech ID: 19383 / UC Case 2008-173-0

BACKGROUND

Organic thin-film transistors (OTFTs) have great potential for use in displays, optoelectronics, logic circuits, and sensors. OTFTs suffer from drift, which is the on state and off state current change over time due to bias stress. Bias stress is the accumulation of charge in the organic films. This is a ubiquitous phenomenon in organic/polymer semiconductors because these materials always have trap states, which are defects that hold charge. In an OTFT transistor, all the conductivity occurs in the first 5 monolayers (about 2nm) of semiconductor. All the rest of the organic/polymeric semiconductor is just excess material, which contains traps that can degrade the device performance. Over time, the organic/polymeric films absorb molecules from the atmosphere creating bias stress.

TECHNOLOGY DESCRIPTION

Ultrathin OTFTs are of technical interest as a possible route toward reduced bias stress in standard OTFTs. UC San Diego researchers have developed such ultrathin OTFT devices and methods of fabricating and processing the same. The invention enables achieving nanosculpted contacts with lower contact resistance that are key to fabrication of ultra thin devices with significantly lower bias stress and better performance than in devices of conventional thickness. It also facilitates recovery from chemical contamination as may occur during manufacture of any OTFT device or atmospheric aging of OTFT chemical sensors. Specifically, the invention's bilayer photoresist lift-off process for ultrathin OTFTs provides three orders of magnitude decrease in contact resistance, two orders increase in field effect mobility, one order increase in on/off ratio, a factor of three decrease in threshold voltage, and considerably reduced defect percentage relative to conventionally fabricated devices. Further, the invention's restore/passivate method in effect reverses the aging process. Currently all organic devices (OTFTs and OLEDs) have to be hermetically sealed because of the bias stress induced by the atmosphere. Sealing the devices helps, but the films are exposed to the atmosphere during processing. Improved device performance and longer lifetime are achievable with defects removed prior to sealing using the invented method. The technique thus enhances device manufacturability, reliability, and yield.

APPLICATIONS

A particular implementation of ultrathin OTFTs is in chemical field-effect transistors, which thereby exhibit far lower drift, making superior sensors. More generally, the major application of OTFTs is as drivers for OLED televisions, which are expected to be the successor technology to LCD TV. The primary application of polymer TFT is expected to be in RFID tags. In the long term, organic or polymer based photovoltaics are also expected to be a big market.

INTELLECTUAL PROPERTY INFO

This invention has a patent pending and is available for sponsored research and/or licensing.

RELATED CASES

See also SD2007-176, SD2007-282, and SD2007-313.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,637,344	01/28/2014	2008-173

CONTACT
University of California, San Diego
Office of Innovation and Commercialization
innovation@ucsd.edu
tel: 858.534.5815.

OTHER INFORMATION

KEYWORDS
OTFT, polymer TFT, OLED, chemFET, optoelectronics, organic photovoltaics, logic circuits, sensors, RFID

CATEGORIZED AS
- **Materials & Chemicals**
  - Thin Films
- **Semiconductors**
  - Materials
- **Sensors & Instrumentation**
  - Other

RELATED CASES
2008-173-0, 2007-176-1, 2007-176-2, 2007-282-1, 2007-313-1, 2007-313-2

University of California, San Diego
Office of Innovation and Commercialization
9500 Gilman Drive, MC 0910, ,
La Jolla,CA 92093-0910

Tel: 858.534.5815
innovation@ucsd.edu
https://innovation.ucsd.edu
Fax: 858.534.7345