

## Solution Processable La<sub>2</sub>O<sub>3</sub> Dielectric Films for Low Operation Voltage Flexible Memory Applications

W. E. He<sup>†</sup>, X. B. Lu<sup>†,\*</sup>

<sup>†</sup> Institute for Advanced Materials, South China Academy of Advanced Optoelectronics, and Guangdong Provincial Key Laboratory of Optical Information Materials and Technology, South China Normal University, Guangzhou 510006, China (luxubing@m.scnu.edu.cn)

### Abstract

Nonvolatile memory devices based on organic thin-film transistors (OTFTs) have been widely studied as one of the leading flexible memory technologies. In spite of substantial progress in terms of selecting and optimizing charge-blocking and/or tunneling layers, OTFT devices reported to date still suffer from a series of deficiencies that hinder the extensive use of OTFTs in practical applications. These deficiencies include high operating voltage, low operating speed, poor reliability, etc.

In this study, we fabricated a high quality amorphous La<sub>2</sub>O<sub>3</sub> dielectric film at low temperature via a low-cost solution process and realized a flexible nonvolatile memory made by using pentacene as semiconducting channel, poly( $\alpha$ -methylstyrene) as charge trapping layer, and solution processed amorphous La<sub>2</sub>O<sub>3</sub> film as charge blocking layer, deposited in sequence on Au-coated flexible muscovite substrate, as shown in Figure 1(a). The device with 120°C-annealed La<sub>2</sub>O<sub>3</sub> film shows a very low gate leakage current (1.66 nA at -4 V) during the  $I_{ds}-V_{gs}$  voltage scanning cycle (Figure 1(b)).

A memory window as wide as  $\Delta V_{th} = 1.0$  V is achieved at a low continuous sweeping voltage between  $\pm 4.5$  V under the 365 nm-UV light. When it was applied with pulsed program (+8 V/1 ms)/erase (-7 V/100  $\mu$ s) voltages, the flexible OTFT shows the excellent electrical performance such as operation speed as fast as 100  $\mu$ s, largest memory window as wide as 2.7 V. In summary, flexible OTFT memory device with a solution processable La<sub>2</sub>O<sub>3</sub> is promising for future applications in low power consumption and wearable flexible nonvolatile memory devices.

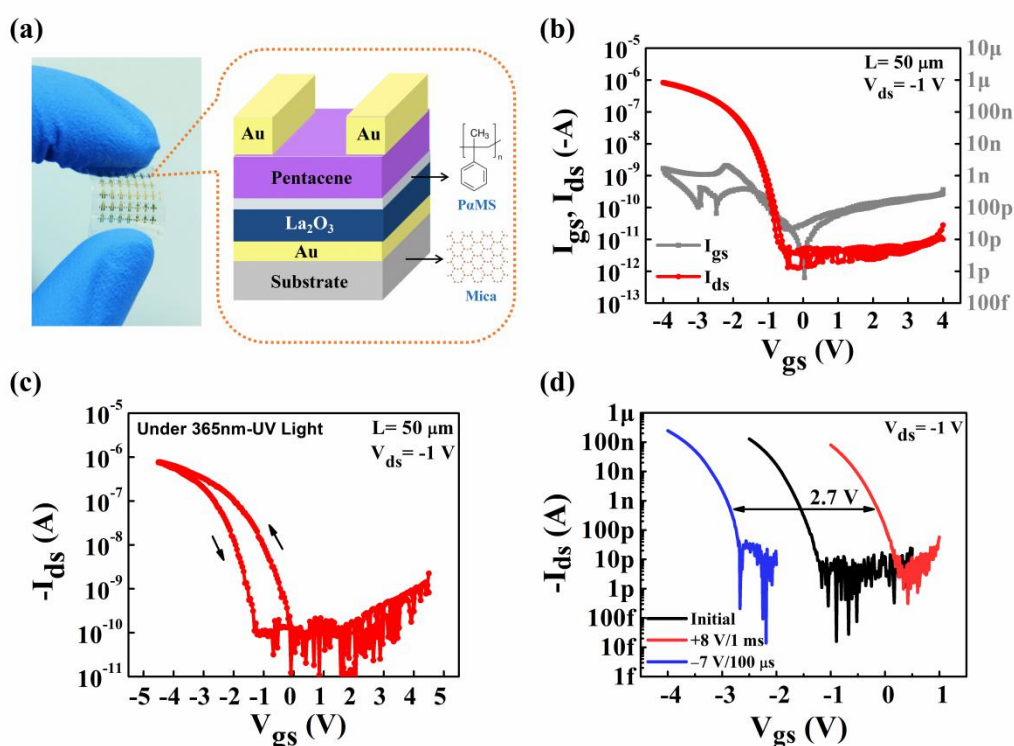


Figure 1: (a) Schematic diagram of flexible OFET memory. Memory characteristics of devices with solution processed amorphous La<sub>2</sub>O<sub>3</sub>; (b) Typical  $I_{ds}$ - $V_{gs}$  curve for devices, where  $V_{ds} = -1$  V; (c) Typical  $I_{ds}$ - $V_{gs}$  curve for memory devices under the 365 nm-UV light, where  $V_{ds} = -1$  V; (d) Typical transfer curves after +8 V/1 ms program and -7 V/100  $\mu\text{s}$  erase pulses.

## References

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