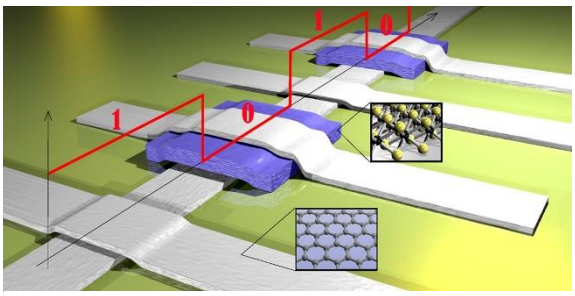
Inkjet Printed 2D Material Logic Memory Device

BACKGROUND



Schematic of a printed logic memory device made from ink-jet graphene

Read-only memory has a variety of applications, including RFID tags, blu-ray, barcode scanners and encryption. However, in recent years it has been overshadowed by the commercial success of transistor based CMOS microchips. The process of designing and building microchips remains expensive, so for more basic applications a cheaper alternative is desirable. Printed electronics, made by depositing conductive inks onto a substrate, are faster to produce, less wasteful, less hazardous and less expensive than conventional techniques. For effective inkjet printing of electronic devices, the inks used need to meet specific physical requirements, such as correct viscosity and surface tension, low evaporation at ambient temperatures, and low levels of impurities in the formulations.

THE TECHNOLOGY

This technology uses inkjet printing to produce writable memory devices. Graphene based inks are used for printing conductive portions of the device, with hexagonal boron nitride based inks for the dielectric portions. By using inks comprising 2D inorganic crystals, many problems commonly associated with inkjet printing of electronics have been mitigated. The writing memory sequences happens during the printing process, a word is stored through the definition of a horizontal stripe, with vertical stripes representing each bit of the word. Logic “1” is stored by short circuiting the bit line to the word line, “0” is achieved by including a dielectric between the bit and word lines. This allows each word to be read when a voltage is applied to the word line by measuring the resistance of each bit, with a “1” corresponding to a higher voltage than a “0”. The technology allows spatial storage capacity of at least 1 bit per 100 μm^2. The technology has numerous applications and represents the first logic memory made using 2D crystals.

KEY BENEFITS

Use of inkjet printing technology:

- Allows design flexibility
- 1 bit per 100 μm^2 spatial storage capacity
- Faster, less wasteful, less hazardous and less expensive than conventional techniques

Use of inks based on 2D inorganic crystals:

- Overcomes common problems with inkjet printing, such as head clogging
- Allows printing of very thin and flexible circuits
- Takes advantage of the exceptional physical properties of 2D materials

APPLICATIONS

This technology can be used to produce:

- Smaller, flexible identification tags
- Biocompatible devices
- Devices for use in education
- Devices for localized signal amplification
- Repair methods for commercial electronics
- Rapid prototypes for the electronics industry
- Add logic circuits to “Lab-on-a-chip” devices
- Circuits for “e-paper”

INTELLECTUAL PROPERTY

Patent application filed

PUBLICATIONS

McManus, Daryl et al. (2017) "Water-Based And Biocompatible 2D Crystal Inks For All-Inkjet-Printed Heterostructures". *Nature Nanotechnology*

OPPORTUNITY

Collaboration to further develop the technology

CONTACT

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UMIP Ref: 20160127