Inorganic and Composite Printed Electronics 2014-2024

Description:

There is increasing work on printed inorganics as people struggle with the performance of organics in some aspects. For conductors with vastly better conductance and cost, for the best printed batteries, for quantum dot devices and for transistor semiconductors with ten times the mobility, look to the new inorganics. That is the emerging world of new nanoparticle metal and alloy inks that are magnitudes superior in cost, conductivity and stability, such as the flexible zinc oxide based transistor semiconductors working at ten times the frequency and with best stability and life, along with many other inorganic materials. Read the world's only report that pulls all this together in readable form.

This report critically compares the options, the trends and the emerging applications. It is the first in the world to comprehensively cover this exciting growth area. The emphasis is on technology basics, commercialisation and the key players.

This report is suitable for all companies developing or interested in the opportunity of printed or thin film electronics materials, manufacturing technologies or complete device fabrication and integration.

Contents:

1. EXECUTIVE SUMMARY AND CONCLUSIONS
   1.1. Printed electronics
   1.2. Mainly inorganic
   1.3. The opportunity for chemical companies
   1.4. Inorganic vs organic
   1.5. Photovoltaics
   1.6. Progress with Semiconductors
   1.6.1. Oxide Semiconductors
   1.6.2. Carbon Nanotubes
   1.6.3. Organics
   1.6.4. Others
   1.7. Printed electronics needs new design rules
   1.7.1. Metamaterials, nantennas and memristors
   1.8. Inorganic compounds for future 2D crystal devices

2. INTRODUCTION
   2.1. Printed electronics - reasons why
   2.2. Impact of printed electronics on conventional electronics
   2.3. Progress so far
   2.3.1. The age of silicon
   2.3.2. The dream of organic electronics
   2.3.3. The example of smart clothing
   2.3.4. Slow progress with organic conductors
   2.3.5. Boron nitride - tailoring carbon composites
   2.3.6. Molybdenum disulfide
   2.4. The new inorganic printed and thin film devices
   2.4.1. Rapidly widening choice of elements - déjà vu
   2.4.2. Metamaterial solar cells and sensors
   2.4.3. Example - printed lighting
   2.4.4. Example - printed photodetectors
   2.4.5. Inorganic barrier layers - alumina, silicon nitride, boron nitride etc

3. INORGANIC TRANSISTORS
   3.1. Inorganic compound semiconductors for transistors
   3.1.1. Learning how to print inorganic compound transistors
   3.1.2. Zinc oxide based transistor semiconductors and Samsung breakthrough
   3.1.3. Aluminium oxide n type transistor semiconductor
   3.1.4. Amorphous InGaZnO
   3.1.5. Gallium-indium hydroxide nanoclusters
3.1.6. Gallium arsenide semiconductors for transistors
3.1.7. Transfer printing silicon and gallium arsenide on film
3.1.8. Silicon nanoparticle ink
3.1.9. Molybdenite transistors at EPFL Lausanne
3.1.10. Carbon nanotube TFTs at SWeNT
3.2. Inorganic dielectrics for transistors
3.2.1. Solution processed barium titanate nanocomposite
3.2.2. Alternative inorganic dielectrics HafSOx etc
3.2.3. Hybrid inorganic dielectrics - zirconia
3.2.4. Hafnium oxide - latest work
3.2.5. Aluminium, lanthanum and other oxides
3.3. Hewlett Packard prints aSi backplanes reel to reel
3.4. Inorganic transistors on paper
3.5. Progress Towards p-type Metal Oxide Semiconductors
3.6. High-Mobility Ambipolar Organic-Inorganic Hybrid Transistors
3.7. Hybrid inorganic/organic transistors and memory
3.7.1. Resistive switching
3.7.2. Oxides as anodes
3.8. Do organic transistors have a future?
3.9. Latest progress
3.9.1. Oxide Semiconductors
3.9.2. Carbon Nanotubes
3.9.3. Organics
3.9.4. Nickel oxide transistors and sensors
3.9.5. Inorganic transistors for ubiquitous RFID
3.9.6. Others

4. INORGANIC PHOTOVOLTAICS AND THERMOELECTRIC
4.1. Performance criteria and limitations of silicon photovoltaics
4.2. Comparison of photovoltaic technologies
4.3. Non-silicon inorganic options
4.3.1. Lowest cost solar cells - CuSnZnSSe?
4.3.2. Copper Indium Gallium diSelenide (CIGS)
4.3.3. Gallium arsenide
4.3.4. Gallium arsenide - germanium
4.3.5. Gallium indium phosphide and gallium indium arsenide
4.3.6. Cadmium telluride and cadmium selenide
4.3.7. Bismuth ferrite - new principle of operation
4.3.8. Porous zinc oxide
4.3.9. Polymer-quantum dot devices CdSe, CdSe/ZnS, PbS, PbSe
4.3.10. Cuprous oxide PV
4.3.11. Other inorganic semiconductors for PV
4.4. Inorganic-organic and carbon-organic formulations
4.4.1. Titanium dioxide Dye Sensitised Solar Cells (DSSC)
4.4.2. Zinc oxide DSCC photovoltaics
4.4.3. Development of high-performance organic-dye sensitized solar cells
4.4.4. Fullerene enhanced polymers
4.5. Other recent advances
4.6. Cobalt, phosphate and ITO to store the energy
4.7. Major US funding for thin Si, CIGS/ZnMnO, DSSC photovoltaics
4.8. Nanoplasmonic silicon film photovoltaics

5. BATTERIES AND SUPERCAPACITORS
5.1. Printing large rechargeable batteries and supercapacitors
5.2. Applications of laminar batteries
5.3. Technology and developers
5.3.1. All-inorganic printed lithium electric vehicle battery: Planar Energy
5.3.2. Battery overview
5.3.3. Blue Spark Technologies, USA
5.3.4. CEA Liten
5.3.5. Enfucell
5.3.6. Imprint
5.3.7. Infinite Power Solutions, USA
5.3.8. Printed battery research
5.3.9. Rocket Electric, Bexel, Samsung, LG Chemicals and micro SKC batteries for Ubiquitous Sensor Networks
5.3.10. SCI, USA
5.3.11. Showa Denko KK Japan
5.3.12. Solicore, USA
5.3.13. The Paper Battery Co
5.3.14. Zirconium disulphide
5.4. Smart skin patches
5.5. Nano metal oxides with carbon create new supercapacitor

6. CONDUCTORS, SENSORS, METAMATERIALS AND MEMRISTORS
6.1. Silver, indium tin oxide and general comparisons.
6.2. Conductor deposition technologies
6.3. Breakthroughs in printing copper
6.3.1. Challenges with copper
6.3.2. University of Helsinki
6.3.3. NanoDynamics
6.3.4. Applied Nanotech Holdings
6.3.5. Samsung Electro-Mechanics
6.3.6. Intrinsiq announces nano copper for printing
6.3.7. NovaCentrix
6.3.8. Hitachi Chemical
6.4. Conductive Inks
6.5. Progress with new conductive ink chemistries and cure processes
6.5.1. Novacentrix PulseForge
6.6. Pre-Deposit Images in Metal PDIM
6.7. Transparent conductors/electrodes by metal patterning and transparent materials
6.7.1. Metal patterning
6.7.2. Nanocarbon hybrid transparent electrodes
6.8. Transparent conductors by growth of metal
6.9. Particle-free silver inks
6.9.1. University of Illinois
6.10. Printed conductors for RFID tag antennas
6.10.1. Print resolutions required for high performance RFID tag antennas
6.10.2. Process cost comparison
6.10.3. RFID tag manufacture consolidation and leaders
6.11. Printing wide area sensors and their memory: Polyscene, Polyapply, 3Plast, PriMeBits, Motorola
6.12. Phase Change Memory, Cu and Ti oxides etc
6.13. Printing metamaterials
6.14. Quantum Tunneling Composites (QTC)
6.15. Flexible memristors
6.16. Company profiles
6.16.1. ASK
6.16.2. Poly-Flex
6.16.3. Avery Dennison
6.16.4. Sun Chemical (Coates Circuit Products)
6.16.5. Mark Andy
6.16.6. InTune (formerly UPM Raflatac)
6.16.7. Stork Prints
6.17. Aerosol jet printing by Optomec
6.18. Electroless plating and electroplating technologies
6.18.1. Conductive Inkjet Technology
6.18.2. Meco
6.18.3. Additive Process Technologies Ltd
6.18.4. Ertek
6.18.5. Leonhard Kurz
6.18.6. Hanita Coatings
6.19. Polymer - metal suspensions
6.20. Comparison of options
6.21. Dry Phase Patterning (DPP)
6.22. Inorganic biomedical sensors
6.22.1. Disposable blocked artery sensors
6.22.2. Disposable asthma analysis

7. NANO TUBES AND NAN W I R E S
7.1. Nanotubes
7.2. At Stanford, nanotubes + ink + paper = instant battery
7.3. Carbon Nanotubes and printed electronics
7.4. Developers of Carbon Nanotubes for Printed Electronics
7.5. Nanorods in photovoltaics
7.6. Zinc oxide nanorod semiconductors
7.7. Zinc oxide nano-lasers
7.8. Indium oxide nanowires
7.9. Zinc oxide nanorod piezo power
7.10. Zinc oxide piezotronic transistors

8. INORGANIC AND HYBRID DISPLAYS AND LIGHTING
8.1. AC Electroluminescent
8.1.1. Fully flexible electroluminescent displays
8.1.2. Watch displays
8.1.3. MorphTouch™ from MFLEX
8.1.4. Electroluminescent and other printed displays
8.2. Thermochromic
8.2.1. Heat generation and sensitivity
8.2.2. Duracell battery testers
8.3. Electrophoretic
8.3.1. Background
8.3.2. Applications of E-paper displays
8.3.3. Electrochromic E-Paper using ZnO Nanowire Array
8.3.4. The Killer Application
8.4. Colour electrophoretics
8.5. Inorganic LED lighting and hybrid OLED
8.5.1. Nth Degree Technologies - printing LED lighting
8.5.2. Tungsten oxide OLED Hole Transport layer
8.6. Affordable electronic window shutters
8.7. Quantum dot lighting and displays

9. COMPANY PROFILES
9.1. Boeing Spectrolab
9.2. Cambrios
9.3. DaiNippon Printing
9.4. Evonik
9.5. G24i
9.6. Hewlett Packard
9.7. InkTec
9.8. ITRI Taiwan
9.9. Kovio Inc
9.10. Miasolé
9.11. NanoForge
9.12. Nanogram Teijin
9.13. NanoMas Technologies
9.15. Samsung
9.16. Soligie
9.17. Toppan Forms

10. TIMELINES, SIZING OF OPPORTUNITIES AND MARKET FORECASTS
10.2. Materials
10.3. Devices
10.3.1. Photovoltaics
10.3.2. Other products
Ordering:

Order Online - [http://www.researchandmarkets.com/reports/3031018/](http://www.researchandmarkets.com/reports/3031018/)

Order by Fax - using the form below

Order by Post - print the order form below and send to

Research and Markets,
Guinness Centre,
Taylors Lane,
Dublin 8,
Ireland.
Fax Order Form
To place an order via fax simply print this form, fill in the information below and fax the completed form to 646-607-1907 (from USA) or +353-1-481-1716 (from Rest of World). If you have any questions please visit http://www.researchandmarkets.com/contact/

Order Information
Please verify that the product information is correct and select the format(s) you require.

Product Name: Inorganic and Composite Printed Electronics 2014-2024
Web Address:  http://www.researchandmarkets.com/reports/3031018/
Office Code: SCDK3X3C

Product Formats
Please select the product formats and quantity you require:

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic (PDF) - 1 - 5 Users</td>
<td>☐</td>
<td>USD 3854</td>
</tr>
<tr>
<td>Electronic and Hard Copy (PDF)</td>
<td>☐</td>
<td>USD 4146 + USD 58 Shipping/Handling</td>
</tr>
</tbody>
</table>

* Shipping/Handling is only charged once per order.

Contact Information
Please enter all the information below in BLOCK CAPITALS

Title: [ ] Mr [X] Mrs [ ] Dr [X] Miss [ ] Ms [ ] Prof [ ]
First Name: ___________________________ Last Name: ___________________________
Email Address: * ___________________________
Job Title: ___________________________
Organisation: ___________________________
Address: ___________________________
City: ___________________________
Postal / Zip Code: ___________________________
Country: ___________________________
Phone Number: ___________________________
Fax Number: ___________________________

* Please refrain from using free email accounts when ordering (e.g. Yahoo, Hotmail, AOL)
Payment Information

Please indicate the payment method you would like to use by selecting the appropriate box.

☐ Pay by credit card:  You will receive an email with a link to a secure webpage to enter your credit card details.

☐ Pay by check:  Please post the check, accompanied by this form, to:
Research and Markets,
Guinness Center,
Taylors Lane,
Dublin 8,
Ireland.

☐ Pay by wire transfer:  Please transfer funds to:
Account number:  833 130 83
Sort code:  98-53-30
Swift code:  ULSBIE2D
IBAN number:  IE78ULSB98533083313083
Bank Address:  Ulster Bank,
27-35 Main Street,
Blackrock,
Co. Dublin,
Ireland.

If you have a Marketing Code please enter it below:

Marketing Code: ____________________________

Please note that by ordering from Research and Markets you are agreeing to our Terms and Conditions at http://www.researchandmarkets.com/info/terms.asp

Please fax this form to:
(646) 607-1907 or (646) 964-6609 - From USA
+353-1-481-1716 or +353-1-653-1571 - From Rest of World