

ONLINE DATABASE OF MATERIALS FOR PRINTED ELECTRONICS

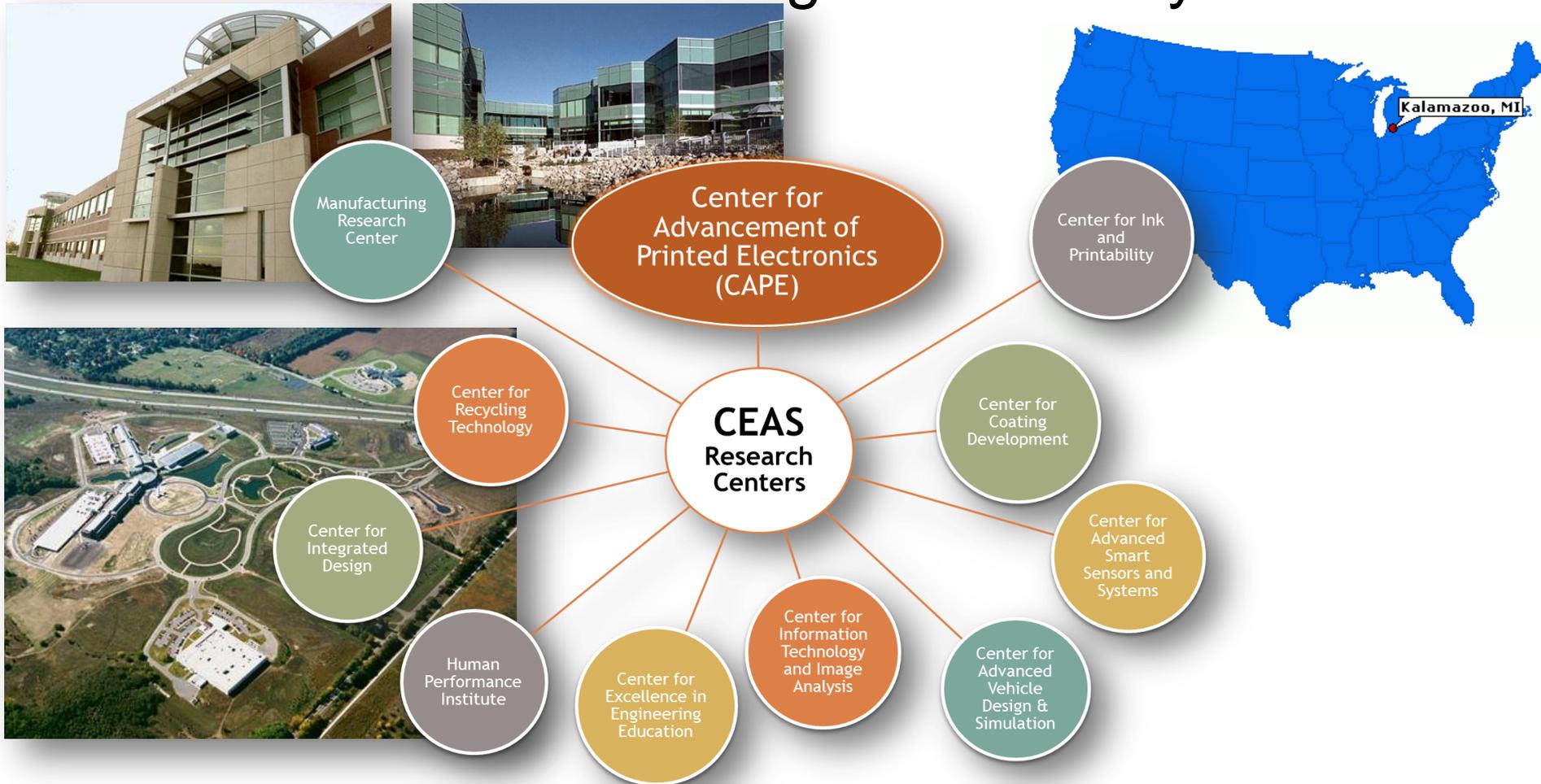
Margaret K. Joyce

Erika Rebrosova, Massood Z. Atashbar and Marian Rebros

Center for the Advancement of Printed Electronics
Western Michigan University



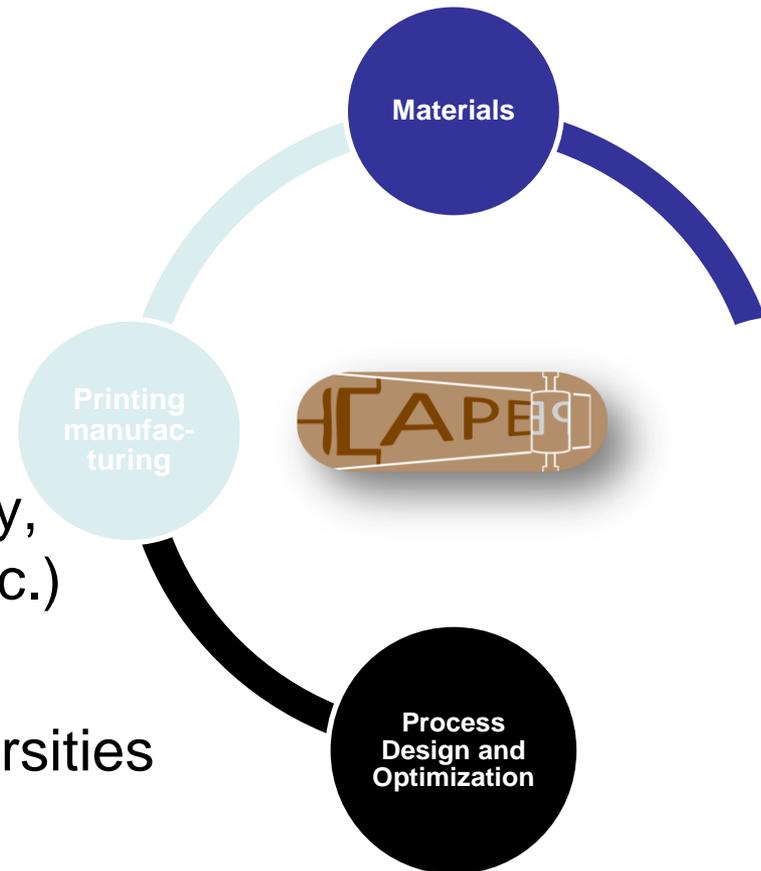
Center for Advancement of Printed Electronics at Western Michigan University



*WMU Parkview Campus at Business
Technology and Research Park 343,000-sq ft
facility completed in 2003*

Center for Advancement of Printed Electronics

- **Purpose:** to advance the field of printed electronics by facilitating resources for research and development of relevant technologies
- **Multidisciplinary team**
- Laboratory and Pilot Scale Printing Facilities
- Extensive array of Testing Equipment (inks, substrates, surface metrology, electrical characterization, etc.)
- **Established partnerships** with industry and other universities

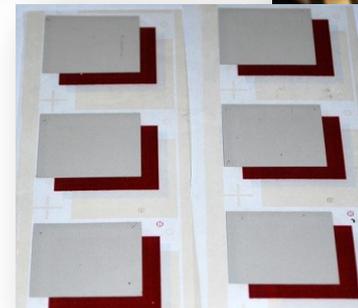
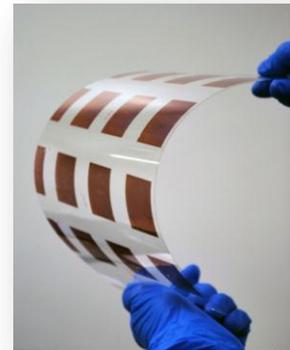


Main Activities

- Focus on fully printed devices
- Microgravure printing
- Functional ink development
- Printable Transparent Conductors (e.g. CNT, PEDOT:PSS, nanowires, ITO, etc.)
- Applications: sensors, polymer photovoltaics, TFTs, capacitors, EL, etc.

MASTERING PRINTED ELECTRONICS PRINCIPLES

- 2-days workshop with hands-on sessions at CAPE
- Presented by industry leaders and CAPE faculties
- Demonstration of AccuPress and other printing presses
- On site fabrication of simple electronic devices and their characterization



Materials Registry for Printed Electronics

- WMU's CAPE received an award from FlexTech Alliance to create an **online database** for accessing technical information on **functional materials used in manufacture of printed and flexible electronics.**
- **Purpose:**
 - provide increased access to technical information about available products – both research and commercial
 - facilitate greater visibility of material suppliers within the printed and flexible electronics supply chain.
 - strengthen printed electronics industry supply chain

Data Management Software

- FlexTech Alliance licensed **GRANTA MI™** software by **Granta Design Limited**.
 - well known system for materials information management in engineering enterprises.
 - specifically designed to store materials properties and other data relating to materials.
 - software tools help you to control, analyze, and apply that data.



GRANTA
MATERIAL INTELLIGENCE

Materials Registry – Main Page

- MI Printed Electronic Materials
 - Applications
 - Subset: No Subset
 - 01. Photovoltaics
 - 02. OLED
 - 03. OTFT
 - 04. Integrated Circuits
 - 05. RFID
 - 06. Memory
 - 07. Sensors
 - 08. Batteries
 - 09. Membrane Switches
 - 10. Interconnects
 - 11. Electroluminescence
 - 12. Other
 - Barrier Coatings and Encapsulants
 - Conductive Materials
 - Subset: No Subset
 - Inorganic
 - Organic
 - Other
 - Deposition Technique
 - Subset: No Subset
 - 01. Gravure Printing
 - 02. Flexography
 - 03. Screen Printing
 - 04. Inkjet Printing
 - 05. Other
 - Dielectric Materials
 - Semiconductor Materials
 - Substrate Materials
 - Supplier Information



WESTERN MICHIGAN UNIVERSITY
Center for the Advancement of Printed Electronics

Printed Electronic Materials Database

Browse The Database:

Applications

- Photovoltaics
- Integrated Circuits
- Sensors
- Interconnects
- OLED
- RFID
- Batteries
- Electroluminescence
- OTFT
- Memory
- Membrane Switches
- Other

Materials

- Semiconductor Materials
- Conductive Materials
- Dielectric Materials
- Substrates
- Barrier Coatings & Encapsulants

Deposition Techniques

- Gravure Printing
- Flexography
- Screen Printing
- Inkjet Printing
- Other

Search The Database:

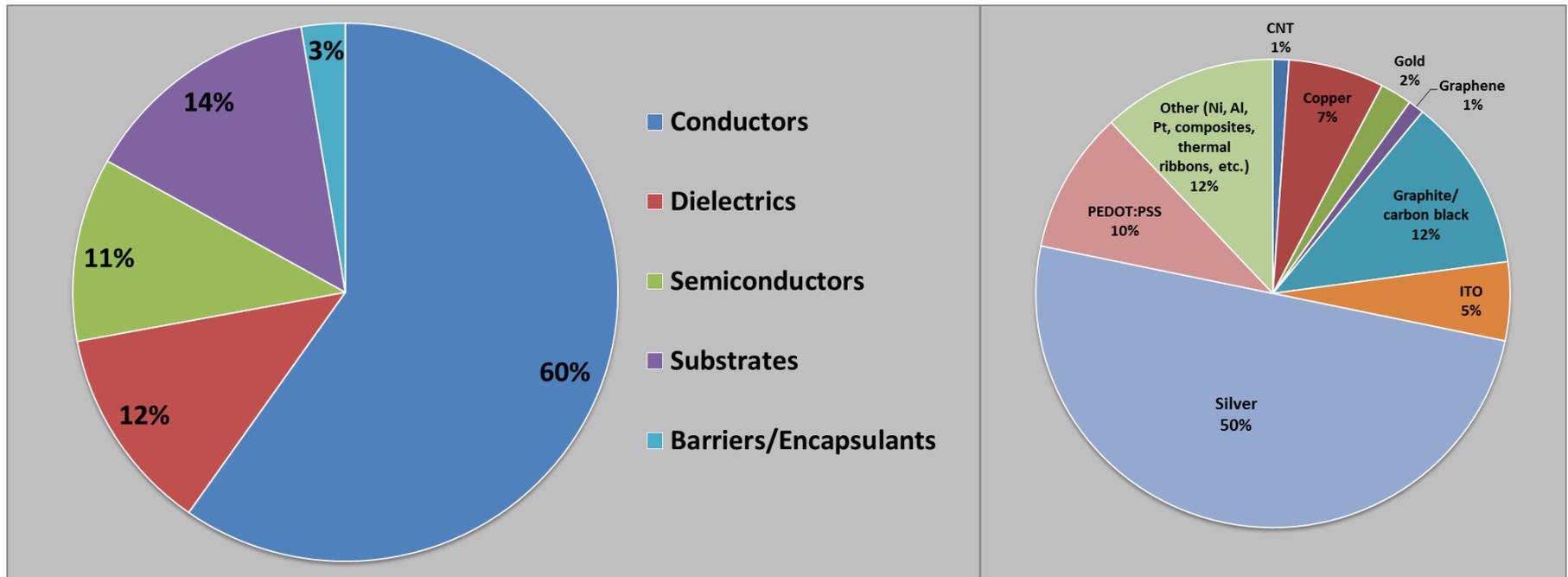
General Search

- Custom Search
- Search by Supplier

Current Status

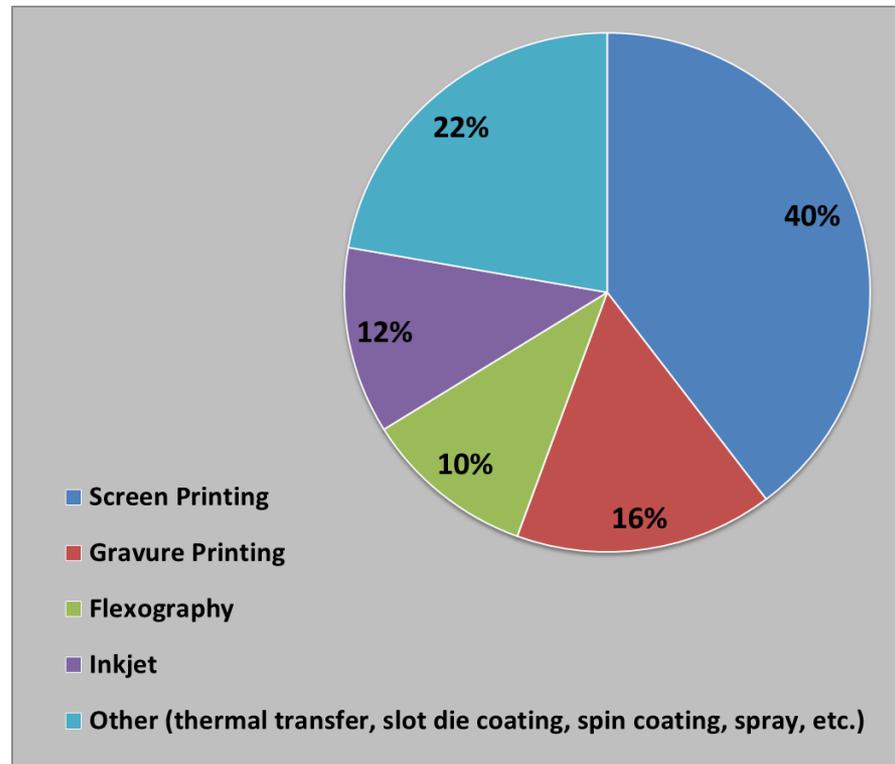
Over 150 products uploaded to database
26+ companies participated

By Material Type



Current Status cont'd

By Deposition Method



DEMONSTRATION

Online Materials Registry

<http://www.wmich.edu/engineer/cape/registry-video.php>

Materials Registry – Main Page

- MI Printed Electronic Materials
 - Applications
 - Subset: No Subset
 - 01_Photovoltaics
 - 02_OLED
 - 03_OTFT
 - 04_Integrated Circuits
 - 05_RFID
 - 06_Memory
 - 07_Sensors
 - 08_Batteries
 - 09_Membrane Switches
 - 10_Interconnects
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WESTERN MICHIGAN UNIVERSITY
Center for the Advancement of Printed Electronics

Printed Electronic Materials Database

Browse The Database:

Applications

- Photovoltaics
- Integrated Circuits
- Sensors
- Interconnects
- OLED
- RFID
- Batteries
- Electroluminescence
- OTFT
- Memory
- Membrane Switches
- Other

Materials

- Semiconductor Materials
- Conductive Materials
- Dielectric Materials
- Substrates
- Barrier Coatings & Encapsulants

Deposition Techniques

- Gravure Printing
- Flexography
- Screen Printing
- Inkjet Printing
- Other

Search The Database:

General Search

- Custom Search
- Search by Supplier

Materials Registry Demo cont'd

- Browsing by Application

GRANTA Mi

read mode
edit mode



View Tools Units

Tools

Contents

MI Printed Electronic Materials

Applications

Subset: No Subset

01. Photovoltaics

02. OLED

03. OTFT

04. Integrated Circuits

05. RFID

06. Memory

07. Sensors

08. Batteries

09. Membrane Switches

10. Interconnects

11. Electroluminescence

12. Other

Barrier Coatings and Encapsulants

Conductive Materials

Subset: No Subset

Inorganic

Organic

Other

Deposition Technique

Subset: No Subset

01. Gravure Printing

11. Electroluminescence

Application Information

Application Electroluminescence

Materials

Dielectric Materials (Electroluminescence)	2 Linked Record(s)
<ul style="list-style-type: none"> Dielctric TTR DuPont 5018 UV Curable Dielectric 	
Conductive Materials (Electroluminescence)	17 Linked Record(s) Show All
Barrier Coatings & Encapsulants (Electroluminescence)	1 Linked Record(s)
<ul style="list-style-type: none"> DuPont 5018 UV Curable Dielectric 	
Substrate Materials (Electroluminescence)	7 Linked Record(s)
<ul style="list-style-type: none"> Acrylic Film CAB film Polyimide Films Polyimide Substrates Polysulfone Films PVC film Ultem Polyetherimide Films 	

No warranty is given for the accuracy of this data

Materials Registry Demo cont'd

- Browsing by Deposition Technique

GRANTA Mi

read mode
edit mode



quick search

Tools

View Tools Units

Contents

04. Inkjet Printing

Deposition Materials

Conductive Materials (Inkjet Printing)

9 Linked Record(s)

- [9101 Conductive Inkjet Ink](#)
- [Ag Conductive ink](#)
- [Cambrios ClearOhmTM](#)

Coating Material

- [Metalon® ICI-003](#)
- [Metalon® JS-011](#)
- [Metalon® JS-015](#)
- [Metalon® JS-B15P](#)
- [Metalon® JS-B25P](#)
- [Metalon® JS-B35P](#)

Semiconductor Materials (Inkjet Printing)

1 Linked Record(s)

- [SP001](#)

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Materials Registry Demo cont'd

- Example of a Material Record

The screenshot displays the Materials Registry software interface. On the left is a navigation tree under 'MI Printed Electronic Materials', with 'Silver (Ag)' selected. The main panel shows the material record for 'PChem nano-silver printable conductors'. Two sections are circled in red: 'General Information' and 'General Characteristics'.

PChem nano-silver printable conductors	
General Information	
Material Name	PChem nano-silver printable conductors
Product Description	
<p>PChem inks offer fast cure and low resistivity, leading to reduced material and processing costs with equivalent or superior performance. All ink formulations are water based, low VOC. Flexographic, screen-printable, and spray formulations are fully commercialized. Gravure, dispenser, letterpress, and offset formulations are in developmental stages awaiting the right business opportunity. Due to the unique stabilization mechanism used for our particles, we do not offer ink-jetable formulations.</p>	
General Characteristics	
Material Type	Ready-To-Use Formulation
Conductive Filler Type	Silver (Ag)
Conductive Filler Loading	40 to 65 wt%
Binder System	no binders - cohesion by sintering
Note : only rheology and adhesion modifiers	
Solvent System	water

Materials Registry Demo cont'd

- Example of a Material Record cont'd

Wet Properties		
Viscosity	100 to 50000 cP	
Note : formulation and shear dependant		
Density	1.5 to 2.5 lb/ft^3	
Note : formulation dependant		
Surface Tension	Not Applicable	
Note : wets most substrates		
Deposition		
Gravure Deposition	No	
Note : Developmental		
Flexo Deposition		
Flexography Records		
Screen Deposition		
Screen Printing Records		
Inkjet Deposition		

Dry Layer Properties		
Electrical Volume Resistivity	0.000005 to 0.00002 ohm.cm	
Electrical Sheet Resistivity	0.02 to 0.4 ohm/sq	
Thickness	0.1 to 2 μm	
Transmission/Transparency	0 to 95 %	
Adhesion	5/5	
Recommended Substrates	Melinex 454 ST505 coated paper, others	
Suggested Applications		
Photovoltaics	Yes	
Photovoltaics Records	1 Linked Record(s)	

Materials Registry Demo cont'd

- Comparison of Materials

The screenshot displays the GRANTA MI Viewer interface. On the left is a tree view of materials, with 'Add to list' circled in red. The main area shows a 'Report' window with a 'Record List' tab. The report contains 11 records, with 'SWeNT™ VC100 CNT Ink' highlighted. On the right, a sidebar offers various report options, with 'Comparison Table' circled in red.

Contents

- MI Printed Electronic Materials
 - Applications
 - Barrier Coatings and Encapsulants
 - Conductive Materials
 - Subset: No Subset
 - Inorganic
 - Carbon Nanotube (CNT)
 - SouthWest NanoTechnologies
 - [SWeNT™ VC100 CNT Ink](#)
 - Add to list**
 - Watch record
 - [Metalon® ICI-020](#)
 - Gold (Au)
 - Graphene
 - XG Sciences, Inc.
 - [xGnP® Graphene Nanoplatelets](#)
 - Graphite
 - Indium Tin Oxide (ITO)
 - Silver (Ag)
 - Cambrios Technologies Corporation
 - [Cambrios ClearOhm™ Coating M](#)
 - DuPont Microcircuit Materials
 - [DuPont 5025 Silver Conductor](#)
 - [DuPont 5069 Silver Conductor](#)
 - [DuPont 7723 Silver Conductor](#)

Report

Record List | File List

Add records by clicking on the 'Add to list' tool on the menus throughout GRANTA MI:Viewer.

You have 11 records in your list. Sort

	Cambrios ClearOhm™ Coating Material	X
	DuPont 5025 Silver Conductor	X
	DuPont 5069 Silver Conductor	X
	DuPont 9169 Silver Conductor	X
	Ag Conductive ink	X
	IINK-FSX	X
	IINK-SSX	X
	Metalon® ICI-003	X
	Metalon® ICI-020	X
	xGnP® Graphene Nanoplatelets	X
	SWeNT™ VC100 CNT Ink	X

Copy To Clipboard Clear List

Comparison Table

X-Y Chart

Export

Bulk Edit: Version Control

Table not version controlled

Data Comparison Chart

The following reports apply to the records in your record list

- Substances affected from records PLAIN
- Substances affected list in CSV format

Materials Registry Demo cont'd

- Comparison of Materials cont'd

Tools Record List View Tools Units

Contents

MI Printed Electronic Materials

- Applications
- Barrier Coatings and Encapsulants
- Conductive Materials
- Deposition Technique
- Dielectric Materials
- Semiconductor Materials
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Report : Attribute List

Browse

MI Printed Electronic Materials

- Conductive Materials
 - General Information
 - General Characteristics
 - Wet Properties
 - Deposition
 - Dry Layer Properties
 - Suggested Applications

Currently Selected Attributes

- Material Type
- Conductive Filler Type
- Electrical Sheet Resistivity
- Electrical Volume Resistivity

Report

Continue

Materials Registry Demo cont'd

- Comparison of Materials cont'd

home search report notify options help quick search

← Modify Report View Tools Units

Report

	✕ <u>Material Type</u>	✕ <u>Conductive Filler Type</u>	✕ <u>Viscosity (cP)</u>	✕ <u>Curing Temperature (°C)</u>	✕ <u>Electrical Sheet Resistivity (ohm/sq)</u>
✕ <u>Cambrios ClearOhm™ Coating Material</u>	Ready-To-Use Formulation	Silver (Ag)	1 to 100	80 to 140	10 to 500
✕ <u>DuPont 5025 Silver Conductor</u>	Ready-To-Use Formulation	Silver (Ag)	20000 to 30000	110 to 170	0.012 to 0.015
✕ <u>DuPont 9169 Silver Conductor</u>	Ready-To-Use Formulation	Silver (Ag)	40000 to 70000	120 to 170	0.012 to 0.018
✕ <u>IINK-FSX</u>	Ready-To-Use Formulation	Silver (Ag)	15 to 20	40 to 70	0.01 to 0.04
✕ <u>Metalon® ICI-003</u>	Ready-To-Use Formulation	Copper	1 to 5	N/A	> 0.14
✕ <u>Metalon® ICI-020</u>	Ready-To-Use Formulation	Copper	0 to 300000	N/A	> 0.04
✕ <u>xGnP® Graphene Nanoplatelets</u>	Powder	Graphene	N/A		
✕ <u>SS 24600</u>	Dispersion	Graphite	3500		0.1 to 40
✕ <u>SWeNT™ VC100 CNT Ink</u>	Ready-To-Use Formulation	Carbon Nanotube (CNT)	50 to 5000		200 to 10000
✕ <u>Cu-iJ70P</u>	Ready-To-Use Formulation	Copper (Cu)	30000 to 40000		
✕ <u>Clevios™ F E</u>	Ready-To-Use Formulation	Organic	10 to 30	120 to 130	110

Save To Excel (CSV) Copy To Clipboard Transpose Table

No warranty is given for the accuracy of this data

Demonstration Video

- Visit FlexTech website
- Check CAPE's website at:

<http://www.wmich.edu/engineer/cape/registry.php>

How Can Your Company Participate in Materials Registry?

- Population of the database is still in progress but now being handled by Abbie Gregg, Inc (AGI).
 1. Send an email to jleslie@abbiegregg.com
 2. You will receive excel importers and instructions on how to complete the forms
 3. Submit the forms

Acknowledgments:

FlexTech Alliance for financial and technical support; **Granta Design Limited** for technical support and **Material Suppliers** for providing data

-  [Applied Nanotech, Inc.](#)
-  [Cambrios Technologies Corporation](#)
-  [DuPont Microcircuit Materials](#)
-  [Dupont Teijin Films](#)
-  [EMD Chemicals, Inc.](#)
-  [Evonik Industries](#)
-  [Felix Schoeller Holding GmbH & Co. KG](#)
-  [Gwent Electronic Materials Ltd](#)
-  [Henkel](#)
-  [Heraeus Materials Technology LLC Conductive Polymers Division](#)
-  [InkTec Co., Ltd.](#)
-  [International Imaging Materials, Inc. \(IIMAK\)](#)
-  [Intrinsic Materials Ltd](#)
-  [Methode Electronics, Inc.](#)
-  [NanoIntegris Inc](#)
-  [NanoMas Technologies, Inc.](#)
-  [Neeah Technical Products](#)
-  [NovaCentrix](#)
-  [PChem Associates](#)
-  [Polyera Corporation](#)
-  [Polyonics, Inc](#)
-  [Seashell Technology](#)
-  [SouthWest NanoTechnologies](#)
-  [Taiyo](#)
-  [VCF Films, Inc.](#)
-  [XG Sciences, Inc.](#)

THANK YOU!

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