

ONLINE DATABASE OF MATERIALS FOR PRINTED ELECTRONICS

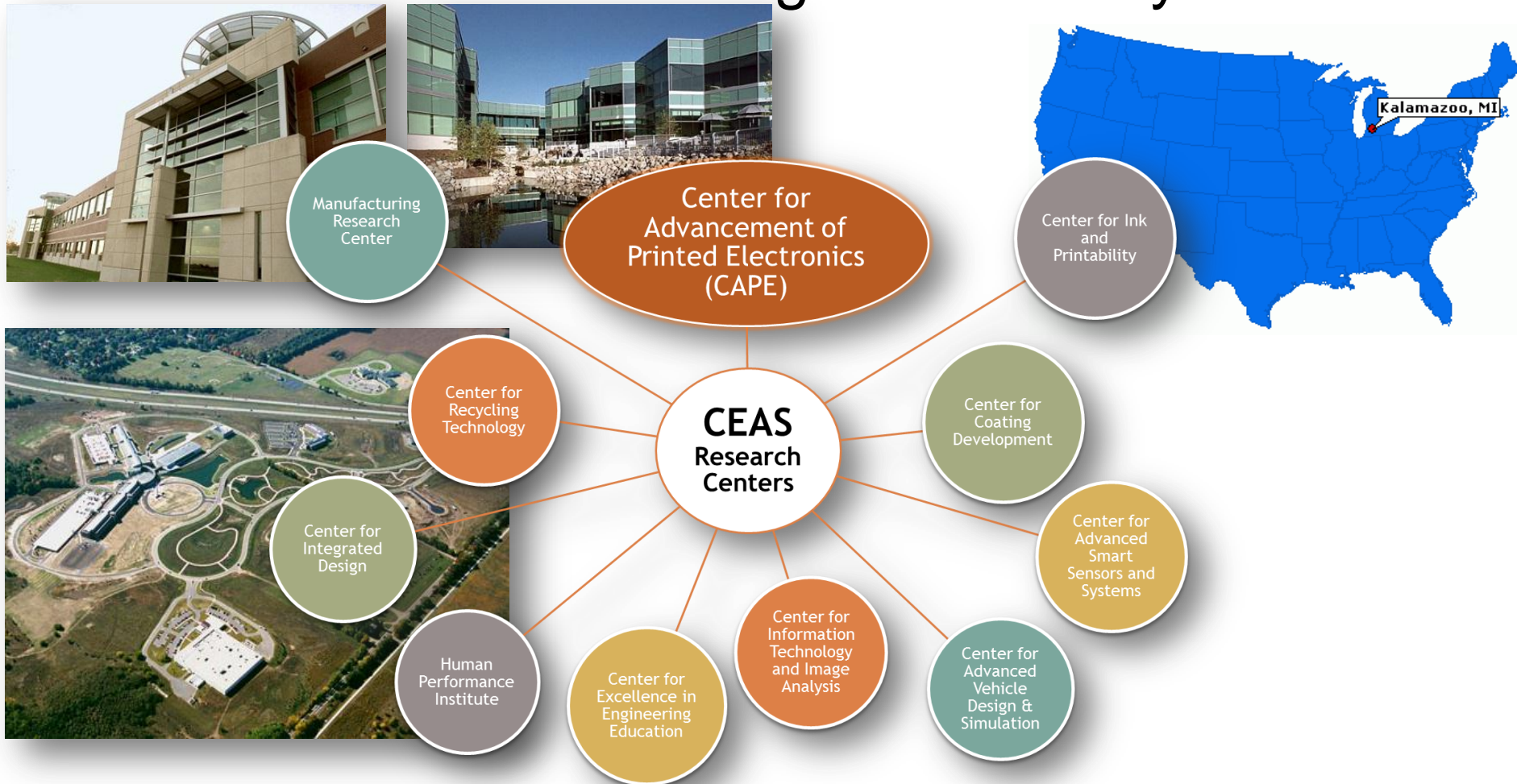
Margaret K. Joyce

Erika Rebrosova, Massood Z. Atashbar and Marian Rebroso

Center for the Advancement of Printed Electronics
Western Michigan University



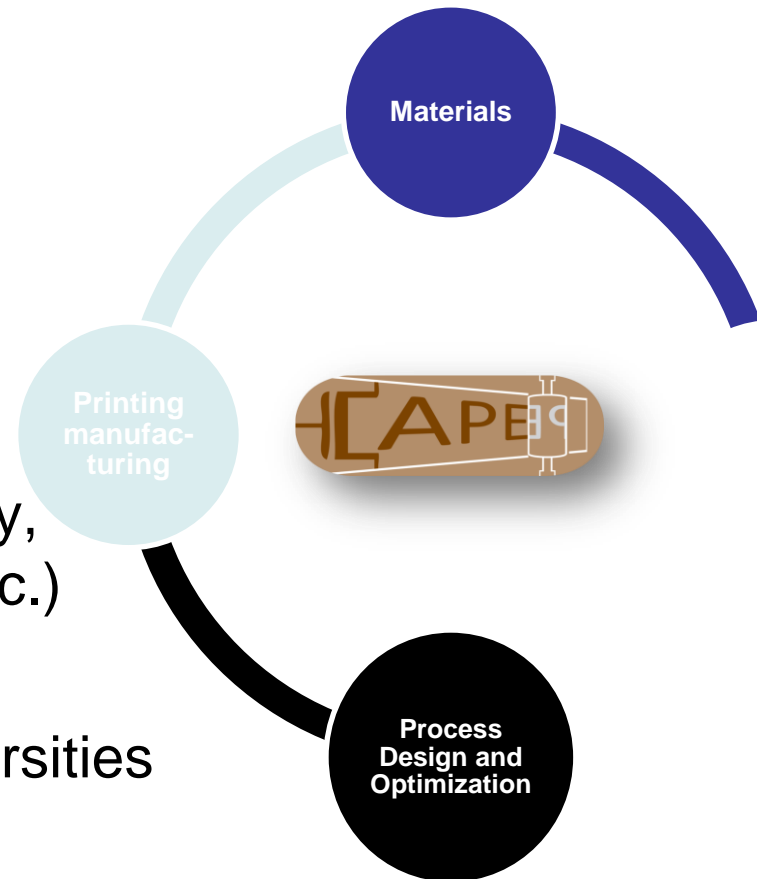
Center for Advancement of Printed Electronics at Western Michigan University



*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

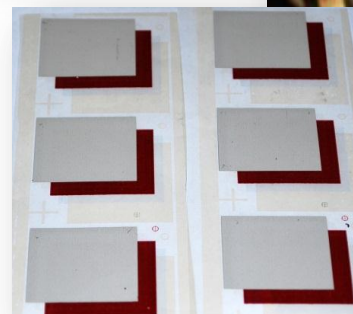
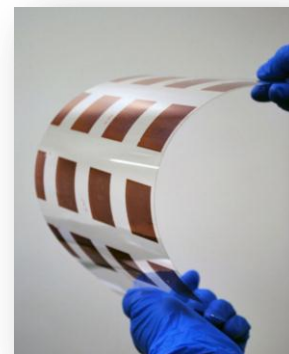


Main Activities

- 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.

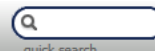


Materials Registry – Main Page

GRANTAMi

Tools

read mode
edit mode



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
- 02. Flexography
- 03. Screen Printing
- 04. Inkjet Printing
- 05. Other

Dielectric Materials

Semiconductor Materials

Substrate Materials

Supplier Information

WMU > College of Engineering and Applied Sciences > C.A.P.E. > Materials Database

GoWMU | WMU A-Z List | Contact WMU



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

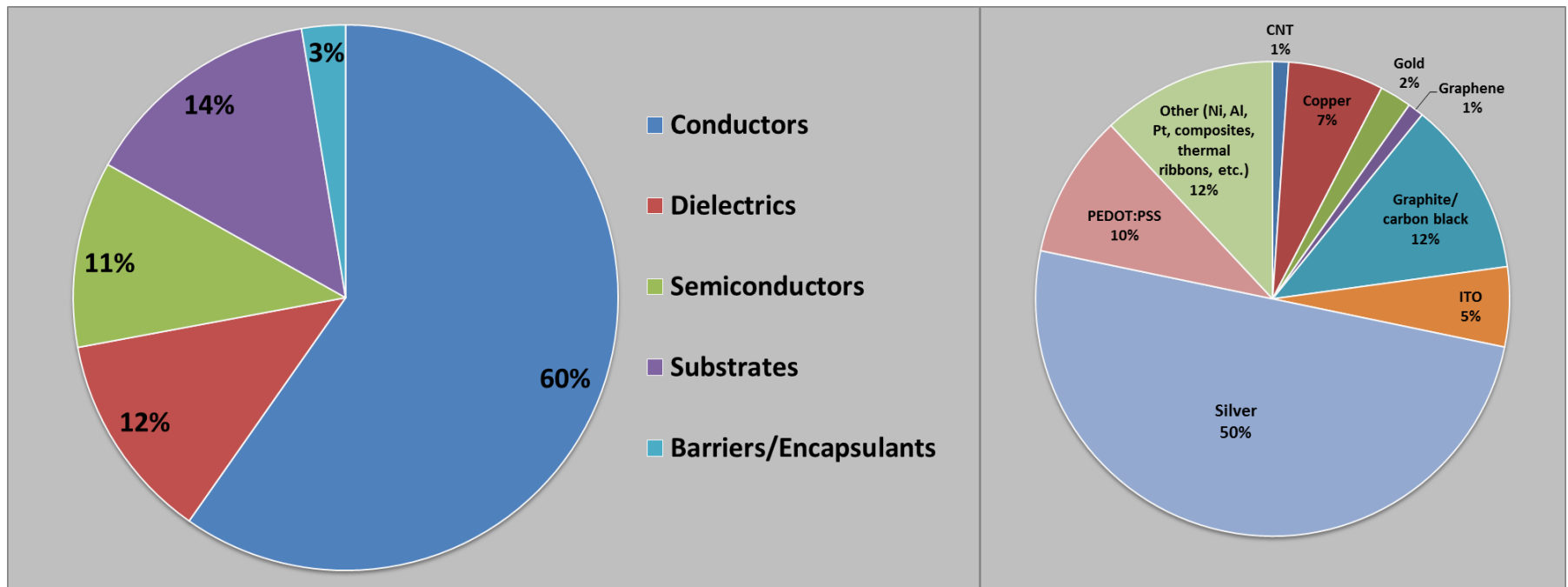
College of Engineering and Applied Sciences
Center for the Advancement of Printed Electronics
Western Michigan University
Kalamazoo MI 49008-5314 USA
Phone: 269-276-3514 | Fax: 269-276-6501

GoWMU | Directories | Contact WMU

Current Status

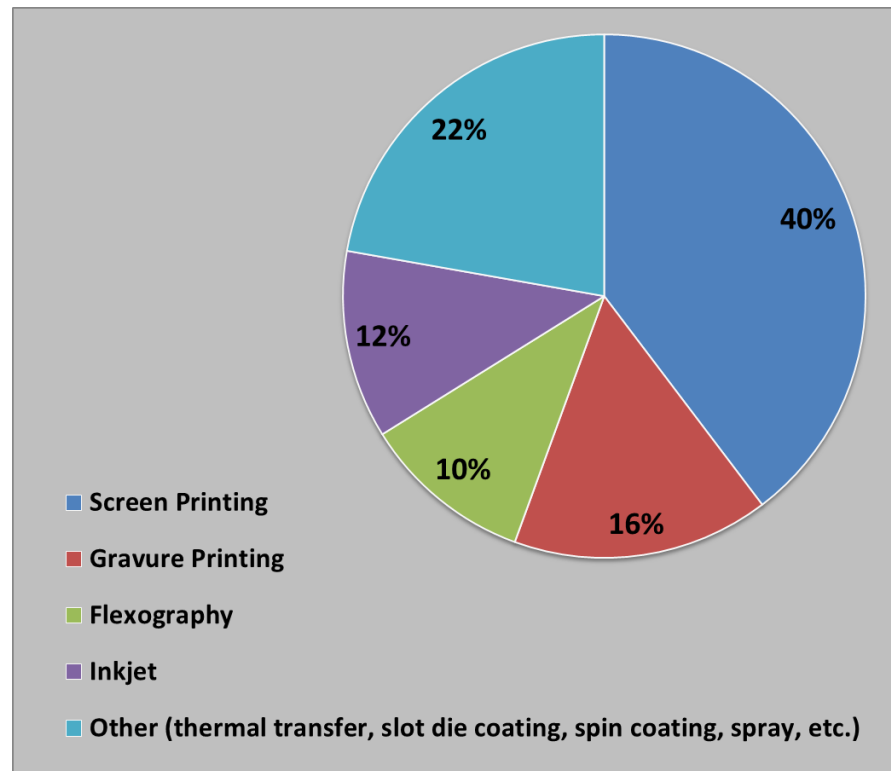
Over 150 products uploaded to database
26+ companies participated

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

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read mode
edit mode



quick search

Tools

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WESTERN MICHIGAN UNIVERSITY
Center for the Advancement of Printed Electronics

Printed Electronic Materials Database

Browse The Database:

Applications

- [Photovoltaics](#)
- [OLED](#)
- [RFID](#)
- [OTFT](#)
- [Integrated Circuits](#)
- [Memory](#)
- [Membrane Switches](#)
- [Sensors](#)
- [Batteries](#)
- [Other](#)
- [Interconnects](#)
- [Electroluminescence](#)

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

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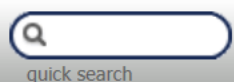
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 - Semiconductor Materials
 - Substrate Materials
 - Supplier Information

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

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- 02. OLED
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- 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)
 - Dielctric TTR
 - DuPont 5018 UV Curable Dielectric
- Conductive Materials (Electroluminescence) 17 Linked Record(s) [Show All](#)
- Barrier Coatings & Encapsulants (Electroluminescence) 1 Linked Record(s)
 - DuPont 5018 UV Curable Dielectric
- Substrate Materials (Electroluminescence) 7 Linked Record(s)
 - Acrylic Film
 - CAB film
 - Polyimide Films
 - Polyimide Substrates
 - Polysulfone Films
 - PVC film
 - Ultem Polyetherimide Films

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Materials Registry Demo cont'd

- Browsing by Deposition Technique

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read mode | edit mode | home | search | report | notify | options | help | quick search

Tools View Tools Units

Contents

- MI Printed Electronic Materials
 - Applications
 - Barrier Coatings and Encapsulants
 - Conductive Materials
 - Deposition Technique
 - Subset: No Subset
 - 01. Gravure Printing
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 - 03. Screen Printing
 - 04. Inkjet Printing**
 - 05. Other
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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 interface. On the left is a 'Contents' tree under the 'MI Printed Electronic Materials' category, showing a hierarchy from 'Inorganic' to 'Silver (Ag)' and finally to 'PChem nano-silver printable conductors'. The main panel on the right shows the detailed record for this material, with tabs for 'General Information' and 'General Characteristics' circled in red.

Contents Tree:

- MI Printed Electronic Materials
 - Applications
 - Barrier Coatings and Encapsulants
 - Conductive Materials
 - Subset: No Subset
 - Inorganic
 - Carbon Nanotube (CNT)
 - Copper (Cu)
 - Gold (Au)
 - Graphene
 - Graphite
 - Indium Tin Oxide (ITO)
 - Silver (Ag)
 - Cambrios Technologies Corporation
 - DuPont Microcircuit Materials
 - InkTec Co., Ltd.
 - International Imaging Materials, Inc. (II)
 - Methode Electronics, Inc.
 - NovaCentrix
 - PChem Associates
 - PChem nano-silver printable conductors**

Material Record: PChem nano-silver printable conductors

General Information

Material Name	PChem nano-silver printable conductors
----------------------	--

Product Description

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.

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/ft³

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

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

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

<http://wmu.materialsdatamanagement.com/mi/reportRecordList.aspx?record=13806>

Materials Registry Demo cont'd

- Comparison of Materials cont'd

The screenshot displays the Materials Registry software interface. The main window shows a tree view of materials, with 'MI Printed Electronic Materials' selected. A 'Browse' dialog is open, allowing the user to select attributes for comparison. The 'Browse' dialog has a 'Choose' tab and a 'Use the' section. The 'Material' section is expanded, showing 'Conductive Materials'. The 'General Information' attribute is selected and highlighted with a red circle. The 'Currently Selected Attributes' list on the right includes 'Material Type', 'Conductive Filler Type', 'Electrical Sheet Resistivity', and 'Electrical Volume Resistivity'. A 'Continue' button is visible at the bottom right of the 'Browse' dialog.

Tools | Record List | View | Tools | Units

Contents

- MI Printed Electronic Materials
 - Applications
 - Barrier Coatings and Encapsulants
 - Conductive Materials
 - Deposition Technique
 - Dielectric Materials
 - Semiconductor Materials
 - Substrate Materials
 - Supplier Information

Report : Attribute List

Browse

Choose... Use the r...

Material

Conduct...

Electrica...

Electrica...

Select the...

Treat zer...

Currently Selected Attributes

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

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>LINK-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. \(IIMAK\)](#)
-  [Intrinsiq Materials Ltd](#)
-  [Methode Electronics, Inc.](#)
-  [NanoIntegris Inc](#)
-  [NanoMas Technologies, Inc.](#)
-  [Neenah 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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