

High-Precision MicroGravure Printing for Printed Electronics

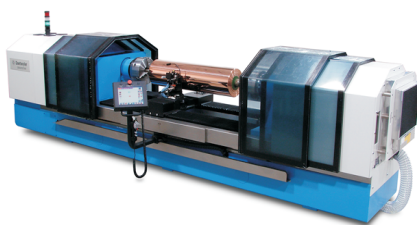
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Company Profile

Ohio Gravure Technologies Inc. has been a leader in the gravure printing industry for over 30 years, with advanced electronic engraving equipment, including our diamond cutting tool, the Vision engrave heads. We have leveraged this expertise for printed electronics applications by enhancing our sub-micron machine control to create the MicroStar™ MicroEngraving system and the AccuPress® Micro-Gravure Printing system. Ohio Gravure Technologies is an international company based in Dayton, Ohio, with customers and equipment in over 50 countries. We are leading the way for high-precision gravure printing for Printed Electronics and more.



The AccuPress MicroGravure System Type 1



The MicroStar MicroEngraving System

Printed electronics has been described as the convergence of printing with electronics, which explains why a manufacturer of gravure printing equipment has expanded into the printed electronics market.

What gravure excels at also applies to printed electronics – extremely accurate cell placement; cell depths for unparalleled ink laydown; stability of data; and long-term consistency.

From an engraving machine to a micro-engraving system was a logical step for Ohio Gravure Technologies.

Gravure's versatility is realized through many non-traditional applications, such as photovoltaics, sensors, RFID, lenticular lenses, medical strips, optics, solar films, security work, embossing, thin conductive lines, organic light-emitting displays, and more. Ohio Gravure Technologies is leading the way for non-traditional uses of gravure with special application engineered cylinders holding accuracies as tight as 5 µm.

MicroStar MicroEngraving

Patented depth control and diamond cutting of our Vision engrave heads allow smooth cut surfaces and cell depth repeatability within 200 nano meter with the MicroStar MicroEngraving System. Features smaller than 5 µm wide have been cut on the MicroStar system.

The extremely accurate high resolution cylinders cut on the MicroStar system have been used in a variety of applications: flexible displays; lenticular lenses for 3 D imaging; medical films, and more.

We work with customers to create the features and patterns required then diamond-cut the cylinder on our MicroStar system. Custom enhancements are routine.

Collage Micro

Collage Micro software is used to provide data for the MicroStar machine to engrave. Collage Micro provides:

- Transition from circuit design / micro-lens design to engraved features
- Multiple file formats accepted, including CAD drawings

AccuPress® MicroGravure Printing

The AccuPress® MicroGravure Printing system was introduced at the Printed Electronics World show in San Jose, CA, December 2009. Designed for the tight tolerances and high accuracy required for printed electronics, this high-precision gravure sheet-fed press uses cylinders (approximately 300 mm x 300 mm) engraved on a MicroStar. This press can be used for lab testing and for limited production.

The machine is highly-customizable, with several levels of accuracy available:

- Level 1 – Single Layer – 20 µm repeatability
- Level 2 – Multi-Layer – 10 µm repeatability
- Level 3 – Enhanced Multi-Layer – 5 µm repeatability
- Level 4 – Ultra-Precision Multi-Layer – >5 µm repeatability

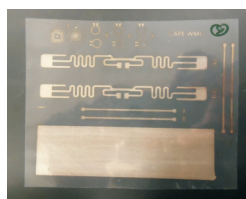
Since 2009, Ohio Gravure Technologies and Western Michigan University have been partners in developing applications for the printed electronics market. An AccuPress Type 3 was installed at CAPE in June 2010, where faculty and doctoral students continue testing with the AccuPress system.

Examples

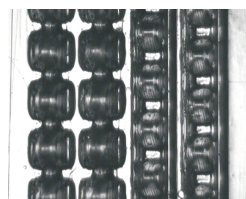
The first picture shows samples printed on AccuPress system. The remaining pictures are highly magnified pictures of features engraved on a MicroStar.



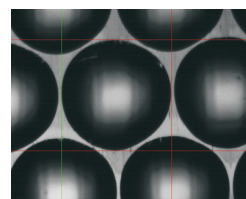
Working OLED sample



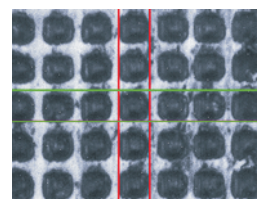
Printed on PET using Nano-Silver ink at WMU CAPE



Variations on vertical lines of 50 µm with 5 µm between



100 µm sphere for micro lens



5 µm feature with 2.5µm space between

Gravure for Printed Electronics

OHIO GRAVURE TECHNOLOGIES INC. offers the equipment, prototyping and support to launch your Gravure Printed Electronics solution. We are leveraging 30 years of gravure industry leadership towards your Printed Electronic application. You will find our knowledgeable R&D team to be adaptable and open to your ideas.

MicroStar™ MicroEngraving System

- High precision engraving machine, with the Collage-Micro advanced data processing capability
- Unique 3-D shapes
- Ink transfer optimization
- Micron lens design for optical film
- Features smaller than 5 μm
- Custom features available
- High productivity with ultra fast diamond cutting tool
 - Control < 200 nm in depth
 - Up to 12,00 features per second
 - < 40 μs rise-time
 - Feedback controlled
 - Cartridge tool design

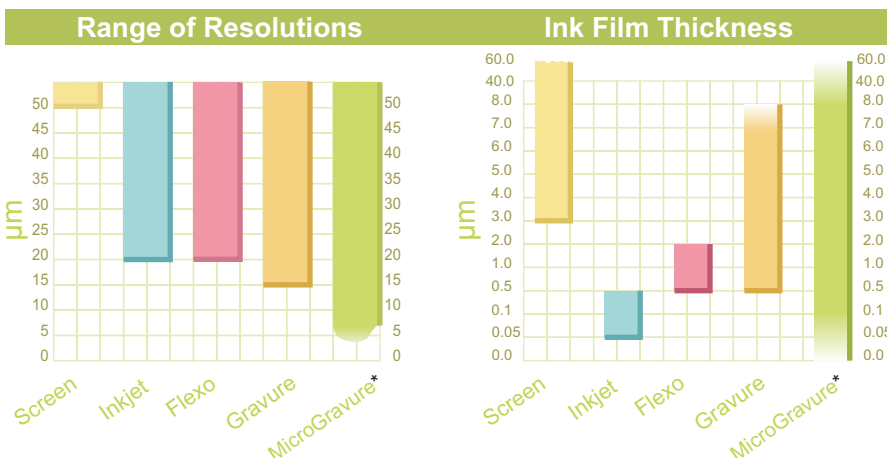
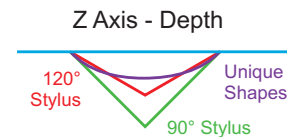
AccuPress® MicroGravure Printing

- Gravure direct printing, Allows hybrid printing
- Lab/limited production, Ink transfer testing
- Single or Multi-layer printing, Layer-to-layer registration
- Custom enhancements
- Levels of automation
- Level 1
 - High precision bearings
 - Accuracy to 20 μm
 - Optional electrostatic assist
- Level 3
 - High precision, air bearings
 - Temperature control
 - Accuracy to 5 μm
 - R2R Path

Benefits of using Gravure for Printed Electronics

- Variety of substrate types due to direct application of ink.
- Variable Ink Film Thickness due to 3-D printing via Z-Axis variability
- Large range of acceptable ink viscosities
- Lowest marginal cost due to lack of waste, long printing roll life, and high print speed
- Versatility
 - Excellent for Highest Resolution application via MicroEngraving and MicroGravure printing
Application - High Density Circuits AND
 - Excellent for large ink lay down via gravure's third axis (Z-depth)
Application - Photovoltaics & Batteries

Gravure adds 3rd axis at high resolution and high speed



Courtesy WMU CAPE November 20, 2009 * In-process, DR&D testing