

Press Release

Heraeus New High-Conductivity Graphene-Based Polymer Thick Film Ink Delivers Improved Conductivity and Environmental Stability

Dramatic 4x conductivity achieved over current commercially available carbon graphite inks.

SANTA CLARA, CA- November 15, 2016- Heraeus Electronics, a leading provider of materials solutions for the semiconductor and electronics communications industries, announced that its new product line of high-conductive, graphene-based inks are now available and ready for high-volume production. With 4x improvement in conductivity, robust lifetime testing stability and a strong cost-effective value proposition, the new low temperature curing thick film ink system provides a superior performing alternative to current commercially available materials. The announcement was made at the IDTechEx Printed Electronics Conference & Exhibition.

Based on materials exclusively licensed from Perpetuus Advanced Materials (<http://perpetuusam.com>), the new Heraeus graphene inks provide an array of significant benefits to the printed electronics industry, including:

- **High conductivity-** achieving 4x improvement (5 ohm offering compared to 20 ohm) over current carbon/graphite systems;
- **Scalability-** while graphene has been previously limited by volume, the new Heraeus graphene inks are available now and can easily scale to meet the high-volume manufacturing needs of customers;
- **Cost effective solution-** provides customers with the option to replace silver-loaded materials, providing a 50% cost improvement compared to silver conductors;
- **Superior performance-** graphene is instrumental in improving lifetime testing stability, exhibiting minor changes in performance over 1,000 hours of exposure.

The Heraeus graphene-based polymer thick film inks are compatible with the company's comprehensive polymer thick film product portfolio. This solution will also support a wide range of critical applications in printed electronics, including low temperatures heaters, bio-sensors, printed batteries and capacitive touch switches.

Frank Stietz, President of Heraeus Electronics, applauded the Heraeus and Perpetuus R&D teams for their breakthrough work to make high-volume graphene ink manufacturing a reality. "Graphene's low volume limitations are no longer an issue. Our revolutionary thick film ink system combines superior performance, cost effectiveness, design flexibility and is immediately available. We believe it's a game-changer for the industry and great news for low-temperature circuit designers, flexible circuit designers and developers."

For more information about the graphene-based polymer thick film ink system, customers can visit the Heraeus Electronics booth (# H18) at the IDTechEx Printed Electronics Conference & Exhibition on November 16th and 17th. To learn more about Heraeus Electronics, please visit www.heraeus-electronics.com.

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About Heraeus

Heraeus, the technology group headquartered in Hanau, Germany, is a leading international family-owned company formed in 1851. With expertise, a focus on innovations, operational excellence and an entrepreneurial leadership, we strive to continuously improve the businesses of our customers around the world. We create high-quality solutions for our customers and strengthen their long-term competitiveness by combining material expertise with technological know-how. Our ideas are focused on important issues such as the environment, energy, health, mobility and industrial applications. Our portfolio ranges from components to coordinated material systems which are used in a wide variety of industries, including the steel, electronics, chemical, automotive and telecommunications industries.

In the 2015 financial year, Heraeus generated revenues without precious metals of €1.9 bn and a total revenue of €12.9 bn. With approximately 12,500 employees worldwide in more than 100 subsidiaries in 38 countries, Heraeus holds a leading position in its global markets. In 2016, the Foundation for Family Businesses named Heraeus as one of the "Top 10 Family Businesses" in Germany.

About Heraeus Electronics

Heraeus Electronics - a Global Business Unit of the Heraeus Group - is one of the leading manufacturers of materials for the packaging of integrated circuits in the electronics industry. The company deals with sophisticated material solutions for semiconductor and automotive industry, consumer goods, energy, industry electronics as well as communications and telecommunications. Core competences include bonding wires, assembly materials, thick film pastes, as well as roll clad strips and substrates.

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