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What's the biggest breakthrough in new material technology this year?

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by Kasey Panetta, Managing Editor

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Paul Kierstead, Director of Marketing, Cree SiC Power

With its proven ability to sustain high power densities in smaller devices, silicon carbide (SiC) material based power devices are now poised to replace silicon (Si) components, creating the potential to revolutionize energy efficiency and system performance in many types of power electronics systems. SiC power electronics devices feature markedly smaller die size for given power-handling capability than are possible using Si technology. Additionally, high power density unipolar SiC devices enable significant reductions in system switching losses versus their bipolar silicon counterparts with SiC MOSFETs and Schottky diodes replacing silicon IGBTs and PIN diodes in high voltage, high power applications. SiC technology has three major benefits: 1) Pure energy efficiency – simply replacing Si devices with SiC devices results in 1-3% higher energy efficiency. 2) SiC devices have inherently better thermal characteristics. Due to their enhanced energy efficiency and superior thermal impedance, SiC enables users to simplify and reduce the cost of their end systems with smaller, and more cost-effective thermal management components. 3) Higher switching efficiencies of SiC devices enable users to increase their system's switching frequency while maintaining high efficiency. Higher frequency operation results in fewer and smaller magnetic and capacitive components improving system size, weight, and cost and reliability. With SiC technology rapidly approaching cost parity with silicon on a system level and SiC devices now offered in an ever-growing array of power ratings and packages, SiC is poised to revolutionize energy efficiency in systems including: solar inverters, servers, communications power, uninterruptible power supplies, trains, windmills, and heavy

industrial power conversion.

Tom Colella, *Engineering Manager, Electrocube, Inc., www.electrocube.com*

Old materials are new again as companies scramble to replace polycarbonate dielectric as a primary material in capacitors. Invented by the Bayer Corporation in 1953 and produced beginning in 1958, the dielectric material was determined to have an operating temperature of -55°C to +125°C without derating. Its insulation resistance and dissipation factor were reasonable, and the size was small in comparison to other dielectrics. Due to its temperature range, polycarbonate dielectric was a preferred material for use in a variety of applications – including military. Since the economy's downturn, many in our industry have been understandably occupied. However, as of 2007, manufacturing of polycarbonate dielectric was discontinued leaving many to find viable alternatives for the material. Here's a quick guide to alternate capacitor dielectrics – replacements for polycarbonate capacitors.



Polyphenylene Sulfide (PPS): The closest dielectric to polycarbonate is polyphenylene sulfide (PPS). The temperature range, electrical parameters, and sizes are similar to polycarbonate.

Polypropylene (PP): The polypropylene dielectric is electrically superior to polycarbonate. The dissipation factor is low at 0.1%. The insulation resistance is high at 100K MegOhm/uf. Its major drawbacks are physical size and temperature range. The temperature range is -55°C to +85°C, derating to 50% at +105°C.

Polypropylene can be a very successful replacement as long as the application is within the temperature limitations. Applications include: coupling/decoupling, by-pass, power factor correction, snubber, filtering and energy storage capacitors.

Polyester (Mylar): The polyester dielectric (Mylar is the DuPont trade name) has been the workhorse of the industry for many years. The electrical parameters are somewhat lower than polycarbonate: the dissipation factor is 1.0%, and the insulation resistance is 20K MegOhm/uf. The temperature range can achieve +125°C as long as the derating is met. The size is relatively smaller than polycarbonate. Successful polyester capacitors applications include: coupling/decoupling, by-pass and filtering applications.



Gordon Margulieux, ECN Reader

MIT has developed a new polymer film that can harvest energy from water vapor. No name yet, but any new materials used for energy harvesting will be big.

Steve McClure - *Vice President Worldwide Sales and Marketing, Semblant*

While super-hydrophobic coatings that repel liquid have been introduced to the market over the last couple years, market leaders now recognize that hydrophobicity alone will not protect an electronic device over time. The biggest breakthrough in new material technology is the introduction of conformal coat materials that use

