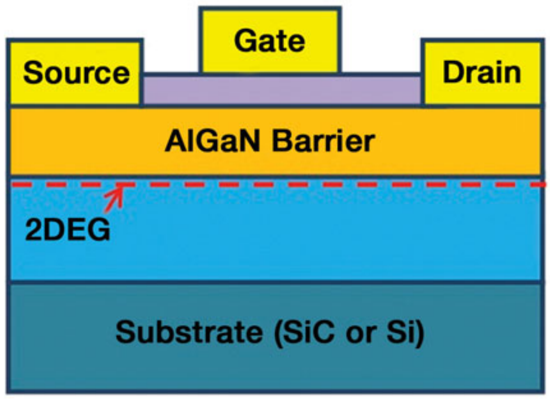

The AlGaN/GaN heterostructure used to fabricate Transphorm's diodes and transistors. The high-electron-mobility channel is also shown.

integrated into the final module solutions are based on the aluminum gallium nitride (AlGaN)/gallium nitride (GaN) heterostructure fabricated into both diodes and transistors. The transistor is a high-electron-mobility transistor. The cross section of the material structure and the device design of a typical device is shown in the figure. The current is carried by a two-dimensional electron gas possessing high electron mobility formed at the AlGaN/GaN interface to neutralize the positive charge that exists at the interface due to the polarization difference between the AlGaN and the GaN. This polarization difference (a materials property) increases almost linearly with Al composition enabling a simple tailoring of the electron density by material composition without the need for doping. This results in extremely high electron mobility, in excess of 2000 cm^{2}V^{-1}s^{-1} with charge densities typically around 1×10^{13}cm^{-2}. The resulting low resistance of the channel coupled by the high breakdown voltage enabled by the high breakdown field strength (>3×10^6cm^{-1}; 10 times that of silicon because of the larger bond strength and bandgap of GaN) results in exceptionally high efficiencies of over 99.2% in converting 200 V dc to 400 V dc and 98.5% in a photovoltaic inverter both in the range of a kW of power at a high frequency of 100 kHz. These results demonstrate that the promise of high-efficiency GaN-based power conversion is now becoming a reality and the market penetration will continue to increase as the technology matures and the advantages of low-loss and small form factor drive new designs.

Opportunities

Transphorm is currently working with and continues to seek to work with companies as customer-partners to help develop new solutions together by combining Transphorm's expertise with that of the customer. The company also works with universities that have an established expertise in power conversion so that the capabilities of the technology can be studied in innovative new architectures and applications including advanced packaging.

Source: Carl Blake, VP Marketing, Transphorm Inc., 115 Castilian Drive, Goleta, CA 93117, USA; tel. 805-456-1300 ext.116; fax 805-968-1985; email cblake@transphormusa.com; and www.transphormusa.com.

Seeing more clearly at the nanoscale

The pitch

Recent advancements in a wide range of instrumentation including high-resolution electron and optical microscopes, chemical analyzers, and spectroscopes allow researchers to see and manipulate matter with unprecedented precision and accuracy. However, despite large investments by universities, government facilities, and industry in these instruments and capabilities, sample preparation and poor sample quality continue to impede characterization accuracy, reproducibility, and throughput. Poor sample preparation creates artifacts such as aggregation or sample damage that introduce uncertainty in data and analysis and that often require multiple samples for a single quality data point or image.

Dune Sciences' patent-pending SMART grids™ functionalized characterization substrates address this problem by imparting greater control over specimen dispersion, coverage, uniformity, and repeatability. In addition, SMART grids facilitate correlated analysis using multiple analytical instruments on the same sample to streamline the characterization process. SMART grids and related characterization products reduce the time and money required for sample preparation and analysis by 50% or more in many cases and result in increased confidence in reporting results due to improved data quality.

The total market for analytical instruments for nanoscale characterization including electron, ion, atomic force and optical microscopes, surface/chemical analyzers, and other equipment exceeded $3 billion in 2009. Dune Sciences' products and services leverage the value of these instruments by maximizing their utility to meet a growing list of application needs in both materials science and life science. In materials science SMART grids standardize sample preparation and provide superior data quality for a wide range of materials for accurate determination of their physical properties (e.g., size and shape), for process optimization and materials integration, manufacturing quality control, failure analysis, and environmental monitoring of nanomaterials to determine their fate and transport. In the life sciences they enhance sample specificity and reproducibility for higher throughput analysis in structural biology, toxicology, pharmaceutical research, and quality control and diagnostic screening (i.e., viral/bacterial).

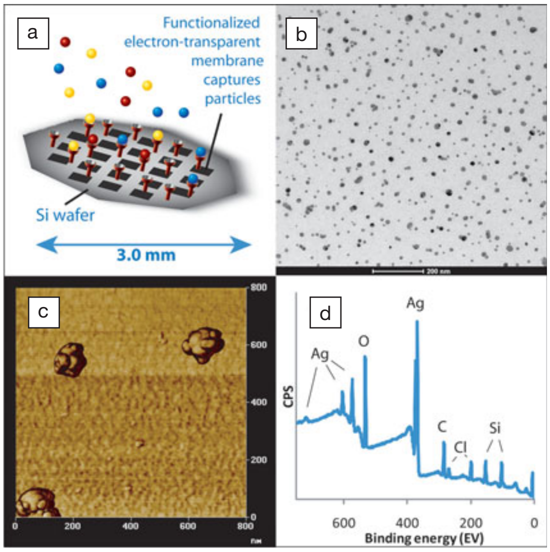

Figure 1. Dune Sciences' SMART grids products capture and immobilize materials for nanoscale characterization using a wide range of analytical tools: (a) SMART grids; (b) transmission electron micrograph of silver nanoparticles (AgNPs) captured on NanoPLUS™ grids; (c) atomic force micrograph of degraded AgNPs on NanoPLUS grid; and (d) x-ray photoelectron spectroscopy results of Ag NPs on NanoPLUS grids.

The technology

SMART grids are unique substrates for nanoscale characterization because, unlike other related products, they have active functionalized surfaces that attract and capture and immobilize materials on the surface using electrostatic and/or chemical interactions (Figure 1a). This feature not only improves sample quality and reduces artifacts for routine sample analysis than is otherwise available, but also markedly changes the role of the characterization substrate from a passive physical support to an active participant in characterization experiments. At the core of this product line are micromachined 3-mm diameter silicon substrates with ultraflat functionalized electron- and optically transparent SiO_2 and low-stress Si_3N_4 membrane windows (Figure 1a).

SMART grids have thermal, chemical, and physical stability that accommodate a wide range of sample preparation and post-deposition processing conditions. In addition, their rigid structure and grid geometry allow for analyzing the same sample using a suite of analytical methods (Figure 1b,c,d), optical microscopy, and other nanoscale techniques to directly correlate structure and function data.

The most recent addition to the SMART grids product line are C-SMART functionalized carbon grids that are tuned for low-contrast materials such as biological molecules and applications including cryoelectron microscopy and tomography. SMART grids are available with various surface chemistries and as sample preparation kits for a wide range of materials and application needs.

An emerging challenge in the commercialization of nanotechnology-enabled products are new regulatory policies being established to minimize any negative impacts on human health and the environment. Dune Sciences' products and services make it possible to investigate nanomaterials under quasi-real-world environmental conditions to determine their fate and more accurately assess their risks.

Opportunities

Dune Sciences is seeking partnerships and collaborations to develop and promote new applications for their products in research and industry.

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