Gallium Oxide – Promising Semiconductor Material

**Based on Frost & Sullivan materials*

As the search for new semiconductor materials is being carried out, wide band gap materials have emerged as possible replacements for silicon. Gallium nitride (GaN) and silicon carbide (SiC) are already in the commercialization stage as they are being used in various high power electronic applications while new materials such as gallium oxide (Ga_2O_3) are being explored as potential semiconductor materials capable of catering to the circuit requirements of power electronics.

Properties of Ga_2O_3

- Gallium oxide has a band gap of 4.8 eV (electron-volt), which is higher than that of GaN or SiC making it a better semiconductor material. Hence, it is suitable for applications, which operate at high temperature and high electric field.
- The beta version of gallium oxide (β-Ga_2O_3) comes in the form of a single crystal and can be used in applications that fall under the ultraviolet spectrum.

Gallium oxide is still in the research phase. Researchers from the University of Buffalo's (UB) School of Engineering and Applied Sciences have successfully fabricated a Ga_2O_3 metal-oxide-semiconductor field-effect transistor (MOSFET), which is 5-micrometers wide. FLOSFIA Inc., a spin out from Kyoto University, is focusing on commercializing its patented technology, the mist CVD technique known as MISTDRY™ technology. It was developed in collaboration with Kyoto University, Advanced Electronic Materials (Fujita Lab), and Araki Lab. FLOSFIA uses mist CVD to fabricate Ga_2O_3 films, which will be integrated with other power electronic components to develop power devices, which consume low power. Using water as the primary source for fabricating, FLOSFIA has successfully fabricated Schottky Barrier Diode (SBD) using MISTDRY™ technology. The corundum structured gallium oxide (α-Ga2O3) resulting from mist CVD technique is fabricated over a sapphire (Al_2O_3) substrate. FLOSFIA has also developed a production line for mass production of power devices using Ga_2O_3 thin films. With the recent funding of $7 million, FLOSFIA is inching toward large-scale commercialization of its Ga_2O_3-based power devices by early 2019. No major semiconductor companies are venturing into Ga_2O_3 at present as its commercial potential is still under evaluation.

Application Scenario of Ga_2O_3

- Major power electronic systems such as UPS (universal power systems), SMPS (switched-mode power supply), and AC drives.
- Hybrid vehicles and high power applications are the key focus areas.
- Ultraviolet detector applications.