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Manufacturing Challenges in Wide Bandgap (WBG) Power Electronics

Krishna Shenai
Principal Electrical Engineer
Energy Systems Division
Argonne National Laboratory
9700 South Cass Avenue, Bldg. 362
Argonne, IL 60439-4815
EMAIL: kshenai@anl.gov

Wide Bandgap (WBG) power semiconductors, especially Silicon Carbide (SiC) and Gallium Nitride (GaN) promise transformative advances in power electronics systems in terms of increased energy efficiency and overall systems miniaturization compared to the conventional silicon-based power electronics systems [1-3]. State-of-the art SiC power diode and power MOSFET devices rated up to 1,700 volts are commercially available; single chip devices rated up to 50 amps and power modules rated in excess of 100 amps are being introduced into the commercial markets. At the same time, lateral GaN power transistors below 600 volts and vertical GaN power diodes rated up to 1,700 volts are entering commercial markets in low volumes. However, die and module costs of WBG power switching technology is prohibitively high compared to similarly rated silicon power switching technology. This paper will discuss manufacturing challenges that must be addressed from wafers to power electronics systems in order to accelerate the market penetration of WBG power switching technology.

[1] K. Shenai, R. S. Scott, and B. J. Baliga, "Optimum Semiconductors for High-Power Electronics," IEEE Trans. Electron Devices, vol. 36, no. 9, pp. 1811-1823, September 1989.

[2] K. Shenai, "Made-to-order Power Electronics," IEEE Spectrum, vol. 37, No. 7, pp. 50-55, July 2000 (**invited paper**).

[3] K. Shenai, “Switching megaWatts with Power Transistors,” to appear in The Electrochemical Society Interface Magazine, vol. 22, no. 1, pp. 47-54, Spring 2013 (**invited paper**).