Advanced processing for energy efficient WBG semiconductors power devices: Recent trends and perspectives

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Today, the energy consumption in our society is steadily increasing and a significant growth of the worldwide electricity demand is expected in the next decade. Hence, a more efficient use of the energy in power conversion systems has become mandatory. In this context, new semiconductor technologies for power electronics, providing a better efficiency than the traditional silicon (Si), are required for the green transition of our society. Wide band gap (WBG) semiconductors, such as silicon carbide (SiC) and gallium nitride (GaN), are the ideal materials for the next generation of efficient power electronic devices. In fact, owing to their excellent properties, they enable superior performances with respect to Si devices in terms of breakdown voltage, on-resistance, leakage current, maximum temperature operation, etc. Hence, SiC and GaN are gradually pervading several important sectors, e.g. consumer electronics, automotive, transportations, energy conversion systems for renewable energies, etc.
Diodes and transistors are elementary active components of all energy conversion systems in power electronics, and a variety of SiC- and GaN discrete devices are already commercialized, such as Schottky diodes, JBS, MOSFETs and HEMTs. While these devices have reached a notable technological maturity, and have replaced the traditional Si power components in many applications, the need to push WBG semiconductors towards their ideal limits is currently the driving force for further technological developments. In this context, metal/semiconductor and insulator/semiconductor interfaces are fundamental building blocks of these devices, requiring to be accurately engineered to optimize the devices performances.
In this talk, after a short introduction on the properties and advantages of WBG in power electronics, some recent achievements of the CNR-IMM group on SiC and GaN device processing and interface reliability will be presented, showing how SiC and GaN technologies are gradually evolving to reduce the energy consumption in power electronics. Finally, the future perspectives and current initiatives on WBG and UWBG technologies will be shortly discussed.