Sustainability with energy efficient wide band gap semiconductors power devices

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Nowadays, a significant fraction of the global greenhouse emissions is due to the electricity production, industry and transportation. In particular, the world energy consumption is expected to grow by nearly 50% until 2050, with a 30% increase in the electricity demand in the next ten years. Hence, to guarantee a sustainable future for our society, a better power and energy management and a more efficient use of the energy have become mandatory. In this context, the development of new semiconductor device technologies for power electronics, providing a better energy efficiency with respect to silicon, is a key enabler for the sustainability transition.

Owing to their outstanding physical and electronic properties, wide band gap semiconductors (WBG) are the most promising materials for the next generation of energy efficient power- and high-frequency devices. Among them, silicon carbide (SiC) and gallium nitride (GaN) are the most mature ones, in terms of crystalline quality and device technology.

While in the last two decades SiC and GaN have already penetrated several strategic market sectors (consumer electronics, automotive, renewable energies, transportation, industry, etc.), new physical problems must be continuously addressed by the scientific community to further improving the devices performances and reduce their manufacturing costs.

This talk will first introduce the fundamental properties of WBG semiconductors, highlighting their figures of merit, and the benefits of using these materials in terms of energy saving in power devices and applications. Then, some case studies related to functional interfaces in SiC and GaN diodes and transistors will be presented, showing how device processing is evolving to reduce the energy consumption in power electronics. Finally, the perspectives of novel WBG semiconductor materials (e.g., bulk GaN, Ga_2O_3, etc.) will be shortly discussed.