LEDs fabricated from gallium nitride have lead to the realization of high-efficiency white solid-state lighting. Currently, commercial GaN white LEDs exhibit luminous efficacy greater than 100 lm/Watt, and external quantum efficiency higher than 50%. This has enabled LEDs to compete with traditional lighting technologies such as incandescent and CFL. Further improvements in materials quality and cost reduction are necessary for widespread adoption of LEDs for lighting. In particular, solving both current “droop” and thermal “droop” has been identified by the USA Department of Energy as key roadblocks to cost reduction and further improvements in LED Lighting. Using advanced light extraction structures we have fabricated advanced GaN white LEDs structures that exhibit luminous efficacy greater than 180 lm/W, and external quantum efficiencies higher than 70% at low current densities. New LED structures grown by MOCVD on semi-polar orientations of GaN on GaN have shown remarkable efficiencies with EQE greater than 50% at high current densities (300A/cm²) and improved thermal droop characteristics. Looking even further into the future, we see Laser Diode based solid-state lighting as impacting high brightness specialty lighting. Recently, we have demonstrated laser-based white lighting with luminous efficacies of 87 lm/W, and over 1000 lumens from a single emitter. Laser-based SSL is already being commercialized in laser projectors and automotive head-lighting.

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