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Pretreatment by selective ion–implantation for epitaxial lateral overgrowth of GaN on patterned sapphire substrate

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Epitaxial lateral overgrowth (ELO) process of gallium nitride (GaN) films on cone–shaped patterned sapphire substrates (PSS) that were pretreated by N^+ ion–implantation was performed by using metal organic chemical vapor deposition. The planar areas of the PSS surface were covered with a 250–nm–thick silicon dioxide (SiO_2) mask to protect them from ion–implantation damages, whereas the cone–shaped patterns of the PSS were exposed to the N^+ ions. The ion–implantation pretreatment was therefore selectively carried out on the cone–shaped pattern of PSS at 67.5 keV with a high dose of 5×10^{17} cm^{-2}. As a result of ion–implantation pretreatment, nucleation growth of GaN poly–grains was inhibited on the cone–shaped patterns that have various crystal planes, such as c–like, R–like, n–like planes. The surface roughness and crystal quality of GaN films grown on the ion–implanted PSS were improved owing to the inhibition of nucleation growth on the patterns. The ion–implantation pretreatment is a very promising technique in ELO process of GaN on an uneven substrate such as cone–shaped PSS that includes various crystal planes.