Effect of SiC substrate properties on structural perfection and electrical parameters of AlGaN/GaN layers

Kira L. Enisherlova¹, Tatyana F. Rusak¹, Vyacheslav I. Korneev¹, A. N. Zazulina¹

¹JSC S&PE “Pulsar”
27 Okruzhnoi proezd, Moscow 105187, Russia

Kira L. Enisherlova (Enisherlova@pulsarnpp.ru) - author for correspondence

K. L. Enisherlova¹ - Dr. Sci. (Eng.), Head of Laboratory (Enisherlova@pulsarnpp.ru); T. F. Rusak¹ - Senior Researcher; V. I. Korneev¹; A. N. Zazulina¹

Abstract. We have analyzed the effect of volume and surface defects in SiC substrates on the structure and electrophysical parameters of AlGaN/GaN epitaxial heterostructures grown on them. Regions with internal stresses usually induced by carbon rich disk-shaped inclusions have been detected in the initial substrates. We show experimentally that the presence of internal stresses in SiC could affect the microroughness of the epitaxial films in regions grown on the stressed areas. An abrupt deterioration of electrophysical parameters occurs in epitaxial film regions growing above internally stressed areas in the substrate. AlGaN/GaN layers contain impurities delivered to their bulk during epitaxy or preparatory operations.

Keywords: epitaxial layers, nitride heterostructures, disk-shaped inclusions, impurity.

Introduction

Single crystal silicon carbide is more promising substrate material compared to sapphire and silicon for the epitaxial growth of AlGaN/GaN heterostructures especially for high-power microelectronics because of the higher heat conductivity, excellent insulating properties and a good match between the SiC and GaN lattices in the basic crystallographic planes. World’s leading high power device manufacturers have already turned attention to this material. For example, Cree Inc. defined its main trend as the development and fabrication of SiC semiconductor devices. It has become the world’s leader in the fabrication of silicon carbide single crystal substrates and epitaxial structures grown on this material [1]. The leaders have already started large scale fabrication of ultrafast HEMTs on SiC substrates [2]. The quality of SiC substrates depends largely on the parameters of ingots that are still imperfect, although since 2006 several international projects have been started in Europe for the improvement of 76-100 mm 4H-polytype single crystal SiC technology [3, 4].

AlGaN/GaN heterostructures are typically grown by epitaxy on single crystal SiC grown in the [0001] direction and having a 4H or 6H polytype lattice. Each polytype has a unique interchanging set of similar Si-C layer pairs. These layers are turned relative to the horizontal axis so that each of the polytypes may contain their cubic or hexagonal closely packed lattices with specific proportions [5]. Therefore the lattice parameter \( a \) of all the polytypes is almost the same. Although the lattice parameter \( c \) determining the identity period differs between the polytypes, it often turns out during the growth of a specific polytype ingot that other polytype regions form inside it. In some instances different polytype modifications sequentially displace one another throughout the whole growth surface producing the so-called sandwich like structures [6].
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات