Ministry of Education & Science of the Republic of Kazakhstan / Қазақстан Республикасы Білім және Ғылым Министрлігі
Министерство Образования и Науки Республики Казахстан

al-Farabi Kazakh National University / әл-Фараби атындағы Қазақ ұлттық университеті
Казахский национальный университет им. аль-Фараби

Proceedings of the Joint International VIII Symposium "Combustion & Plasmochemistry"

The Institute of Combustion Problem. Институт проблем горения. МОН РК - Комитет Науки

and

Scientific & Technical Conference "Energy Efficiency-2015"

National Academy of Science of Ukraine / The Gas Institute
Украинаның Ұлттық Ғылыми академиясы / Газ Институты
Национальная академия наук Украины / Институт газа

Бірлескен VIII "ЖАНУ ЖӘНЕ ПЛАЗМОХИМИЯ" халықаралық симпозиумы мен "ЭНЕРГИЯЛЫҚ ТИІМДІЛІК-2015" ғылыми техникалық конференциясы

Совместный VIII международный симпозиум "ГОРЕНИЕ И ПЛАЗМОХИМИЯ" и научно-техническая конференция "ЭНЕРГОЭФФЕКТИВНОСТЬ-2015"

September, 16-18, 2015, Almaty, Republic of Kazakhstan

УСТНЫЕ ДОКЛАДЫ

DEVELOPMENT OF Y_2O_3/GRAPHENE/COPPER HETEROSTRUCTURE AS A SUBSTRATE MATERIAL FOR GaN EPILAYERS

R. Beisenov[1,2,3], Z. A. Mansurov[2], R. Ibrahim[3], D. Muratov[2], S. Zh. Tokmoldin[1], and A. Ignatiev[1,3]

1. Institute of Physics and Technology, Almaty, Kazakhstan
2. Institute of Combustion Problems, Almaty. Kazakhstan
3. Center for Advanced Materials, University of Houston, Houston, Texas, USA
renat.beissenov@gmail.com

Abstract
In present work,graphene and Y_2O_3thin layers deposited by CVD and PLD on large size Cu foil. The AlNwas grownby RF-sputtering technique at 450^{O}C. The SEM and XRD analysis of AlN/Y_2O_3/graphene/Cu sample shows a smooth surfaceand indicate small AlN (0001) peak.

Because of the excellent optical and electrical characteristics of nitride semiconductors [1,2], full-color-spectrum nitride light-emitting diodes (LEDs) with high efficiency and reliability and long-term stability are now commercially available [3]. These results were outstanding considering the fact that the material was showing very high crystal defect densities (~10^{19}-10^{10} dislocations/cm^2), more than 4 orders of magnitude higher than those in III-As or III-P LEDs [4]. The defects seen in nitride LEDs mainly result from stresses due to their epitaxial growth on foreign substrates. These substrates exhibit differences in lattice parameter, chemical composition and coefficient of thermal expansion (CTE) with GaN. LED manufacturing processes require continuous improvement of the layer quality, wafer uniformity and reproducibility of the epitaxial growth process in order to reduce the production cost and increase wafer size. SiC has lattice and thermal mismatches of 4% and 25% respectively with GaN, and good thermal conductivity. However, SiC has high defect density, including severe influence on epi-GaN quality by SiCmicropipe dislocation defects.

The present work is devoted to deposition of graphene as an intermediate layer between the GaN layer and a metal substrate. Graphene films exhibit high temperature stability, optical transparency, mechanical flexibility, and high electrical and thermal conductivity. Graphene films can now be grown on a large scale on metal foils of Cu, Ni and their alloys. We believe that our approach at using graphene intermediate layers on a metal substrate has two specific advantages: First, the honeycomb lattice structure of the graphene template can offer a platform and flexibility for selected buffer material with hexagonally symmetric lattice structure and (0001) orientation, which may well match that of AlN and GaN. Second, due to the self-assembling and surface inert properties of graphene, the transfer of the material and devices fabricated on graphene onto other substrates will be quite direct.

Such an approach would yield two layers with a 6.1% lattice mismatch (SiC and graphene) – typically too large for good epitaxial growth (lattice mismatch should be less than 2-3%). To further mitigate this lattice mismatch, a Y_2O_3 buffer layer is proposed to be grown by PLD between the graphene and the SiC layer thus having a 1.55% lattice mismatch with graphene in a 1:6 unit cell ratio, and a 2.6% mismatch with SiC. The net mismatch would be less than for SiC directly on graphene. Such a Cu/graphene/Y_2O_3/SiCheterostructure exhibiting a minimization of lattice mismatch for highly epitaxial growth of SiC on graphene, would support the high temperature