Using Graphene like buffer layer for PA-MBE of III-nitrides for high-frequency devices on different amorphous substrates

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Abstract

In this paper, the possibility of graphene using as a 2D buffer layer for epitaxial growth of III-nitrides by PA-MBE on amorphous substrates was investigated. The multilayer graphene films were grown by chemical vapor deposition on copper foil and then transferred onto the surface of 2-inch Si wafers with different dielectric films. After that GaN and AlN epilayers were grown by PA-MBE under the metal-rich conditions using the HT AlN nucleation layer. The comparative study of graphene coated parts of the wafers and the parts without graphene was carried out by scanning electron microscopy and high-resolution X-ray diffractometry including XRD pole figures method. It was shown that epitaxial GaN films with Ga polarity and close to 2D surface morphology can be obtained by PA-MBE on amorphous substrates with multilayer graphene buffer. Such structures (like «GaN-on-Si») may be of interest when developing new devices based on AlIIN heterostructures in combination with conventional silicon CMOS technology or for producing high-frequency devices on different amorphous substrates.

References

[1] J.W. Shon, et al. Scientific Reports, 4, 5325 (2014).
[2] T. Araki, et al. Applied Physics Express, 7 (7), 071001 (2014).

Figures

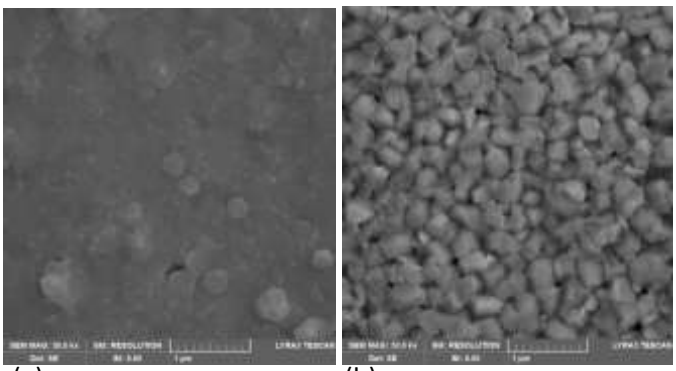

Figure 1: SEM images: (a) - the surface of GaN film on graphene coated part of the substrate, (b) - the surface of GaN film on SiO_2.

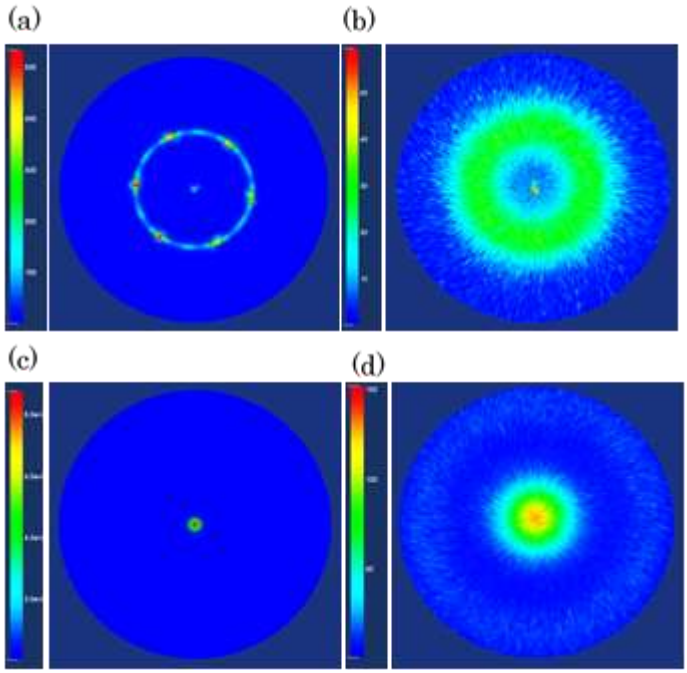

Figure 2: XRD pole figures for the GaN {101$\bar{3}$} (2θ = 63.5˚): (a) - on graphene coated part, (b) - without graphene buffer layer; XRD pole figures for the GaN {0002} (2θ = 34.6˚): (c) - on graphene coated part, (d) - without graphene buffer layer.