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NEW OPTICAL PROPERTIES-SURFACE TEXTURE STUDY OF GAN/SAPPHIRE SUBSTRATE AT ROOM TEMPERATURE FOR NANO-OPTOELECTRONIC DEVICES

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Abstract: -

GaN have gained an unprecedented attention due to their wid-ranging applications. Aiming of this work is to create and develop properties of GaN buffer layer via metalorganic chemical vapor deposition (MOCVD) on Sapphire for Nano-Optoelectronic devices working in UV-Visible region .For that, We have designed simple cheap Stainless Steel cavity for creating new material system(new surface texture -new optical properties).UV-visible emissions, Surface morphologies were changed and characterized by PL (using Ar+ laser for Visible emissions & He Cd laser for UV emissions) and SEM respectively. GaN/Sapphire substrate surface texture and UV-visible emissions were changed, thin film structure becomes wiry network and red shift in UV -new emissions in Visible (~500nm~560nm) with high intensity. In this paper, new properties of GaN/Sapphire were observed, recorded and discussed at room temperature. This study will open up a lot of possibilities concerning the applications and design working in high temperature or unstable conditions.

Keywords: -*Optical and Electrical properties of GaN, Visible and UV emissions of large band semiconductor aterials, Surface texture and Photoluminescence.*

INTRODUCTION:
Since the initial development of GaN optoelectronic technology starting approximately a decade ago . Great progress has been made in the science and technology of GaN and related III-nitrides for the use of blue light emitters and laser applications. High quality GaN wafer is necessary to achieve the long life performance , since most of the GaN wafers are grown on sapphire substrates, it is difficult to get strain-free and dislocation free wafers[1].

Usually, GaN films are grown on Sapphire substrates, due to the relatively large lattice and thermal expansion coefficient mismatches between GaN and Sapphire to obtain high–performance and highpower GaN-based devices is still highly desired [2].

The main idea of this work is to tackle GaN issues and to adjust its properties for new applications. Therefore, this work will open up a lot of possibilities concerning the new applications of GaN buffer layer via metalorganic chemical vapor deposition (MOCVD) on Sapphire for Nano-Optoelectronic devices working in UV-Visible region. We have designed simple cheap S.S cavity for creating new material system(new surface texture -new optical properties),which are characterized by PL (using Ar+ laser for Visible emissions and HeCd laser for UV emissions) and SEM respectively. GaN/Sapphire substrate surface texture and PL emissions in UV-visible region were changed ,red shift in UV and new emissions in Visible with high intensity. New properties of GaN/Sapphire were recorded and discussed in this study at room temperature.

Results and Discussion:
Figures(1-5) show simple cheap S.S cavity design for creating new properties (new surface texture new optical properties of GaN buffer layer via metalorganic chemical vapor deposition (MOCVD) on Sapphire for Nano-Optoelectronic devices working in UV-Visible region, sample cavity as holder, SEM images of the one-dimensional structure of GaN/Saphaier with using cavity and without and PL using Ar+ laser(514.5nm) for Visible emissions & HeCd laser (32.5nm)for UV emissions respectively.

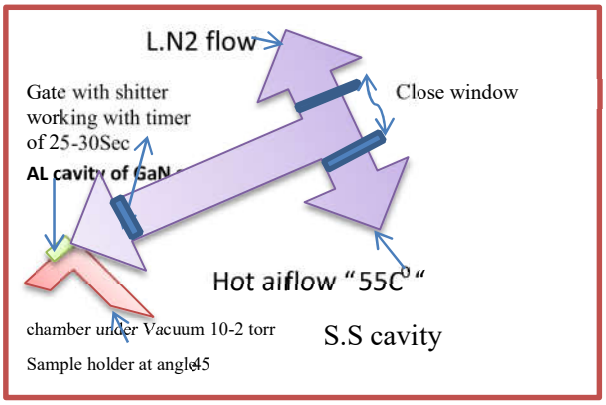

Fig.1 showing Stainless Steel cavity design to creat new surface texture of GaN buffer layer via metalorganic chemical vapor deposition (MOCVD) on Sapphire .

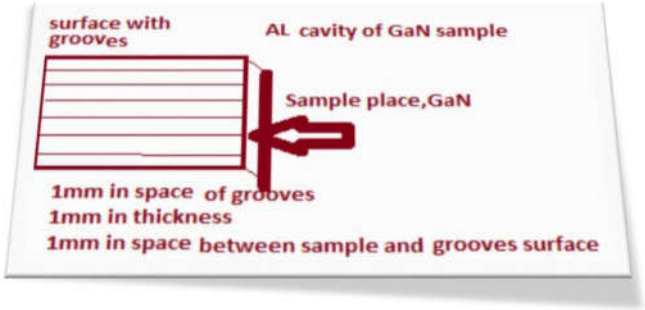

Fig.2 showing sample AL holder design of GaN

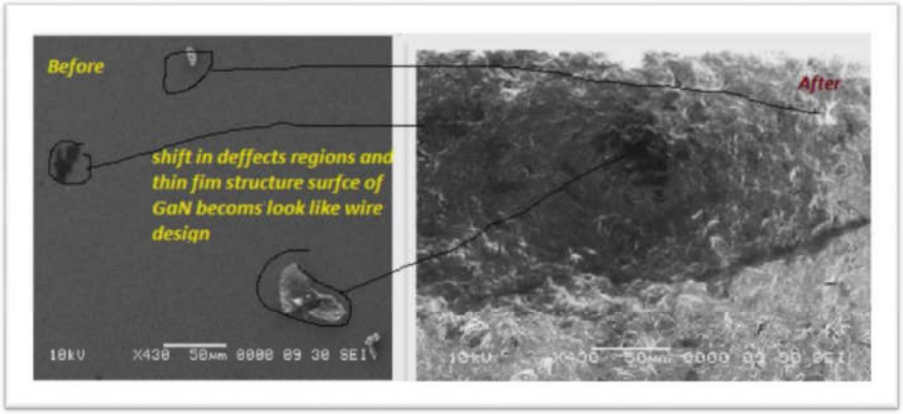

Fig. 3. SEM images of the one-dimensional structure of GaN/Saphaier using method/ S.S cavity and without.

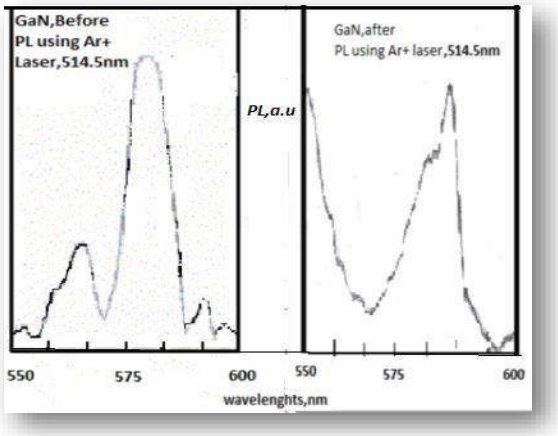

Fig. 4 PL spectra of GaN buffer layer via metalorganic chemical vapor deposition (MOCVD) on Sapphire using Ar+ laser at room temperature.

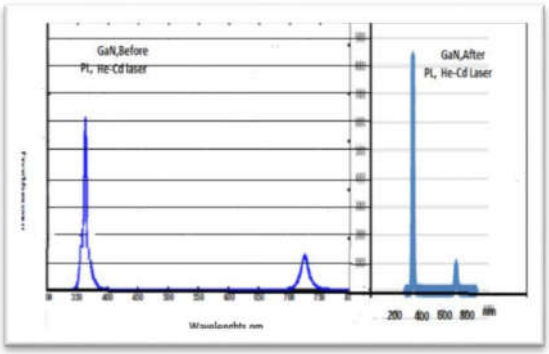

Fig.5 PL spectra of GaN buffer layer via metalorganic chemic vapor deposition (MOCVD) on Sapphire using He-Cd laser.

By using this method as shown in figures (1&2) with optimized conditions made a significant reduction of surface effects in GaN surface texture(wiry network) as shown in figure 3, thus improved the sample quality. We reported an enhancement in the luminescence intensity, new emissions (~<500nm-~>560nm) and shift in wavelengths scale, Red shift as shown in figures (4 & 5).

Ar+ laser and He-Cd PL excitation resulted in an intense emissions from new surface texture with new wavelengths at visible wavelengths are shown in figure 4.PL emissions indicate a new optical properties such as refractive index. Sharp peaks in the spectrum were not as clear due to simple optical cavity design (lenses and optical filters).Results of this study are very important and necessary to achieve the long life performance because surface texture becomes more quality. For emitters applications, high quality GaN wafer is necessary to achieve the long life performance. Since most of GaN wafers are grown on sapphire substrates, it is difficult to get strain-free and dislocations-free wafers. This work efforts were carried out to reduce surface defects and surface texture which may accelerate and open new studies in area of thin film surface profile.

Conclusion:
We have reported and observed for the first time new surface texture and new optical properties of GaN/Sapphire substrate at room temperature for new area of Nano-Optoelectronic devices and their applications using that simple cheap S.S cavity.

As results, new surface structure looks like wiry network (Thin film surface profile was changed) and new emissions with high intensity in spectrum area of (~500nm-~560nm) and red shift in UV region at room temperature.
Results of this work will open up a lot of possibilities concerning the applications and design working of Ga-based materials in high temperature, unstable conditions and space applications.

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