Activity modulation and role of nitrogen radicals in PA-MBE for growth of group III nitrides and their alloys

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Abstract

Production of high quality epitaxial films of group III nitrides and their alloys on a large size Si wafer is requested for high frequency and high power electronics devices. Plasma assisted molecular beam epitaxy (PA-MBE) method, which uses radio frequency inductively coupled plasma (rf-ICP), is the most suitable one for growth of the group III nitrides on a Si wafer. From an original Si wafer a double buffer layer (DBL) AlN/β-Si_3N_4/Si(111) is grown by interface reaction epitaxy (IRE) of Si and successive IRE of β-Si_3N_4 to form AlN. The rf-ICP plasma produces nitrogen radicals such as chemically active nitrogen atoms (N+N*) and physically active excited nitrogen molecules(N_2*).

A DBL of AlN(0001)/β-Si_3N_4/Si(111) has been studied by Wu et. al [1] and present authors [2-4]. Controlling exposure of both (N+N*) and N_2* fluxes is able to use an activity modulation migration enhanced epitaxy (AM-MEE)[4, 5]. On the DBL an AlN(0001) template is grown by an AM-MEE method of PA-MBE. This method is able to make a electronic or optical device from Si wafer with in a one MBE chamber.

In this presentation a new one-chamber growth system for group III nitrids on a large size Si wafer using PA-MBE system is demonstrated. In order to improve quality of the epitaxial films the interface properties of the AlN template and Si substrate is studied by grazing incidence-angle X-ray reflectivity (GIXR) measurement [6].

References

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