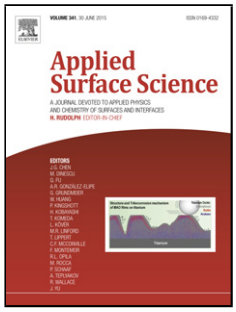

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Influence of metallic surface states on electron affinity of epitaxial AlN films

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Abstract: The present article investigates surface metallic states induced alteration in the electron affinity of epitaxial AlN films. AlN films grown by plasma-assisted molecular beam epitaxy system with (30% and 16%) and without metallic aluminium on the surface were probed via photoemission spectroscopic measurements. An in-depth analysis exploring the influence of metallic aluminium and native oxide on the electronic structure of the films is performed.. It was observed that the metallic states pinned the Fermi Level (FL) near valence band edge and lead to the reduction of electron affinity (EA). These metallic states initiated charge transfer and induced changes in surface and interface dipoles strength. Therefore, the EA of the films varied between 0.6 - 1.0 eV due to the variation in contribution of metallic states and native oxide. However, the surface barrier height (SBH) increased (4.2 - 3.5 eV) adversely due to the availability of donor-like surface states in metallic aluminium rich films.

Keywords: AlN, Photoemission, Electron Affinity, Surface States

Introduction:

Aluminium Nitride (AlN) is a wide band gap (6.2 eV) semiconductor displaying potential application in the development of optoelectronic and electronic devices such as deep ultraviolet (UV) photodetectors, field emitters, quantum cascade lasers, cold cathodes etc.[1-3] Electron affinity (EA) is defined as the energy required to move an electron outside semiconductor surface (i.e. vacuum level) from the bottom of the conduction band. Smaller EA signifies easier extraction of electrons from a surface, thus making AlN a promising material for field-emission (FE) displays and cold cathodes. Benjamin et al [4] first reported the existence of negative electron affinity (NEA) for AlN films. However, the results were disputed and positive EA (upto 2.1 eV) for AlN films was produced by many researchers in later years.[5-7]