URN etd-0407109-183711-881
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Statistics This thesis had been viewed 39 times. Download 0 times.
Department
Year 2005
Semester 1
Degree Master
Type of Document Master's Thesis
Language zh-TW.Big5 Chinese
Title Fabrication of Carbon-nitride Thin-Film by ECR-CVD for Optoelectronic Device Applications
Date of Defense 0000-00-00
Page Count 60
Keyword
Carbon nitride

Abstract
Carbon-nitride is an interesting and important material owing to its several superior properties including high bulk modulus, high hardness, high decomposition temperature, high strength, high thermal conductivity and excellent resistance to corrosion and wear. However, crystalline carbon nitride (c-CN) is difficult to form, and hence its practical applications were greatly limited. The amorphous carbon-nitride (a-CN) thin-film deposited on silicon substrates is a highly functional wide-bandgap semiconductor material due to its similar material characteristics to c-CN. In addition, its optical bandgap is estimated to 4 eV above, making it a suitable candidate for development of short-wavelength or broad-band optoelectronic devices.
In this thesis, a-CN thin-films were deposited on different substrates by an electron-cyclotron-resonant-chemical-vapor-deposition (ECR-CVD) technique. Properties of as-deposited films were adjusted by different microwave power and gas compositional ratios and were characterized by SEM, AFM, XRD, AES, UV/Visible Spectrophotometer and Raman Spectrophotometer.
Experimental results showed that optical band-gaps of a-CN thin-films decreased with increasing microwave power or decreasing compositional ratio of nitrogen in the precursor. It is supposed that lower optical bandgaps were resulted from larger nitrogen-to-carbon ratios (N/C ratios) of films. Higher microwave power induced more intense plasma energy and more decomposition of nitrogen gas, thus making larger N/C ratios and lower optical bandgaps. On the contrary, if the proportion of nitrogen gas in the precursor increased, the plasma density reduced, thus leading to a smaller N/C ratio and a higher optical bandgap.
In conclusion, a-CN thin-films with adjustable optical bandgaps can be deposited by ECR-CVD. It indicated this novel material have great potential for applications in optoelectronic devices.
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Date of Submission 2006-08-08