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The Role of Indium composition on Thermo-Electric properties of InGaN/GaN heterostructures grown by MOCVD

S. Surender[1], S. Pradeep[1], K. Prabakaran[1], S. M. Sumithra[1], Shubra Singh[1], K. Baskar[1,2]
[1]*Crystal Growth Centre, Anna University, Chennai – 600025, India.*
[2]*Manonmanium Sundaranar University, Tirunelveli-627012, India.*

corresponding author email : suren.borntowin@gmail.com, drbaskar2009@gmail.com

Abstract:

Thermo Electric (TE) properties of InGaN /GaN heterostructure with different Indium compositions grown by Metal Orgonic Chemical Vapour Deposition (MOCVD) are investigated. Room temperature thermoelectric studies reveals that increasing indium composition (from 6% to 19%) in the InGaN/GaN heterostructure lead to a decrease in Seebeck coefficient (S) due to sharpening of bandgap which in turn increases TE figure of merit. Seebeck coefficient, Power factor and Figure of Merit of the InGaN/GaN heterostructured thin films shows significant enhancement at higher temperature up to 420K as compared to room temperature measurement. Promising results on the TE properties of as grown InGaN/GaN heterostructures were observed with Figure of Merit (ZT) value of 0.15 at 420 K for $In_{0.19}Ga_{0.81}N$ sample. The results indicate that InGaN material system could be potentially imparted for high temperature TE devices.

Keywords: Thermoelectric, MOCVD, HRXRD, InGaN, Seebeck effect.

Introduction

Thermo Electric (TE) devices have attracted interest due to their many advantages such as electronic capacity controls, all solid state operations and reversibility to provide both cooling and heating together with high reliability [1]. TE materials gained lot of attention due to their possible application in optoelectronic device cooling and heat recycling in electrical power generation. It is equally necessary and challenging to develop TE devices which can operate at high temperatures so as to generate energy from waste heat sources with high temperature. The efficiency of TE devices are represented in terms of Figure of Merit (ZT) which is directly related to the Power Factor (PF) of the device and large value of ZT at high temperatures is required for attaining higher efficiencies. Bi_2Te_3 and PbTe are considered to be highly efficient