Effect of resonant tunneling on electroluminescence in nc-Si/SiO_2 multilayers-based p-i-n structure

D.Y. Chen, Y. Sun, Y.Y. Wang, Y.J. He, G. Zhang

PII: S0040-6090(14)01294-2
DOI: doi: 10.1016/j.tsf.2014.12.035
Reference: TSF 33999

To appear in: *Thin Solid Films*

Received date: 4 June 2014
Revised date: 1 November 2014
Accepted date: 19 December 2014

Please cite this article as: D.Y. Chen, Y. Sun, Y.Y. Wang, Y.J. He, G. Zhang, Effect of resonant tunneling on electroluminescence in nc-Si/SiO_2 multilayers-based p-i-n structure, *Thin Solid Films* (2014), doi: 10.1016/j.tsf.2014.12.035

Effect of resonant tunneling on electroluminescence in nc-Si/SiO_2 multilayers-based p-i-n structure

D. Y. Chen[1,2*], Y. Sun[1], Y. Y. Wang[1], Y. J. He[1], G. Zhang[1]

[1*] *Nanjing University of posts and Telecommunications, Nanjing 210046, China*

[2]*Nanjing National Laboratory of Microstructures and Key Laboratory of Advanced Photonic and Electronic materials, Department of Physics, Nanjing University, Nanjing 210093, China*

chendy@njupt.edu.cn

tel: +86-18936005695

Abstract

P-i-n structures with SiO_2/nc-Si/SiO_2 multilayers as intrinsic layer were prepared in conventional plasma enhanced chemical vapor deposition system. Their carrier transport and electroluminescence properties were investigated. Two resonant tunneling related current peaks with current dropping gradually under forward bias were observed in the current voltage curve. Non-uniformity of the interfaces might be in responsible for the gradually dropping of the current. Electroluminescence intensity of the device under bias of 7 V which is near the resonant tunneling peak voltage of 7.2 V was weaker than that under 6.5 V. According to the Gaussian fitting results of the spectra, the intensity of the sub-peak of 650 nm originating from recombination of injected electrons and holes was decreased the most. When resonant tunneling conditions are met, it might be that most of injected electrons participate in resonant tunneling and fewer in Pool-Frenkel tunneling which is the main carrier transport mechanism to contribute to electroluminescence intensity.

Keywords: resonant tunneling; electroluminescence; SiO_2/nc-Si/SiO_2 multilayers; Poole-Frenkel tunneling;

1. Introductions

Resonant tunneling has been reported and studied extensively in GaAs/AlGaAs [1-3], Si/SiGe [4-5], single-crystalline-Si/amorphous-SiO_2 system [6-7], nc-Si embedded in dielectric matrices such as SiO_2 or SiN*x* [8-14]. And SiO_2/nc-Si/SiO_2 system has some advantages such as process compatibility with microelectronic technology, higher recombination possibility for the small distance between wave functions of electrons and holes than that in bulk silicon, and so on.