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Effect of resonant tunneling on electroluminescence in nc-Si/SiO₂ multilayers-based p-i-n structure

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Abstract

P-i-n structures with SiO₂/nc-Si/SiO₂ 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; SiO₂/nc-Si/SiO₂ 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-SiO₂ system [6-7], nc-Si embedded in dielectric matrices such as SiO₂ or SiN_x [8-14]. And SiO₂/nc-Si/SiO₂ 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.

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