Physico-chemical nanomaterials science.

Electroluminescence energy efficiency of Si-structures with different compound of nanoscale dislocation complexes

M.O. Kushlyk, B.V. Pavlyk, D.P. Slobodzyan

Department of Sensor and Semiconductor Electronics, Ivan Franko National University of Lviv, 79017, 107 Hen. Tarnavskoho Str., Lviv, Ukraine,
E-mail: kushlykmarik@gmail.com

The problem of using silicon for closed cycle of optoelectronic device building technology it is that radiating recombination rate is in several orders of magnitude lower than in direct-band-gap semiconductors. The idea of applying dislocation luminescence for increase radiative recombination is very promising. Dislocations and associated defect-impurity complexes have a high temperature stability and compatibility of luminescence energy to maximum transparency of existing optical fiber structures.

It is shown that plastic deformation and high-temperature annealing in oxygen atmosphere generate high concentration of dislocations on silicon surface (111), which allows to create highly radiative Al-Si (p) structure. Electroluminescence spectra of these structures at different concentration of dislocations, duration of high-temperature annealing and pressure magnitude of elastic deformation were studied. Based on these researches was calculated electroluminescence energy efficiency (η). These calculations show that such manufacturing method of emitting structures in combination with the elastic deformation can increase the value of η up to 2.4%.

It is established that the set of these types of treatment is accompanied by several mechanisms of influence on IR electroluminescence of silicon samples. One of such mechanism is the formation in the subsurface layer a high concentration of nanoscale defect complexes around dislocations core. Consequently of research results comparative analysis of capacitively-modulation spectroscopy of deep levels and IR spectroscopy of vibrational levels with electroluminescence spectra established that these complexes defect can be $E_v + 0.08$ eV (60° dislocation), $E_v + 0.14$ eV (dislocation - V), $E_v + 0.23$ eV (dislocation - Si_I), $E_v + 0.26$ eV (dislocation - O), which correspond to dislocation luminescence centers [1].

1. *B.V. Pavlyk, M.O. Kushlyk, D.P. Slobodzyan . About the nature of electroluminescence centers in plastically deformed crystals of p-type silicon // J. Nano- Electron. Phys.- 2015.- 7(3).- P. 03043-1 - 03043-5.*