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Relaxation kinetics in InGaAs/GaAs quantum dot-chain structures

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InGaAs/GaAs quantum dot-chain heterostructures are known for their unique optical and electrical properties [1, 2]. These structures can be involved to improve novel optoelectronic devices, infrared photodetectors, semiconductor lasers and solar cells [2]. We study photoconductivity kinetics of rise and relaxation in (In,Ga)As quantum dot-chain structures by varying laser excitation at different temperatures.

We investigated (In,Ga)As quantum dot-chain structures SC094 and SC111 using laser excitation 650nm and 980nm at the temperature of 82K. We obtain that the time constant τ is 2.4s for SC094 structure and τ = 2.7s for SC111 under light excitation 650nm. The parameter τ is lower for SC094 and SC111 and equal to 0.6s and 0.7 respectively under excitation 980nm. We reveal that for the both of structures photoconductivity rise is approximated by exponential dependence with β = 0.7 – 1, while relaxation can be described by stretched exponent with β = 0.5 – 0.7.

In addition, temperature dependences of parameters τ and β are examined under in the temperature range 82 – 290K. Obtained results show that parameters τ and β do not depend on temperature for all structures. Therefore, we conclude that tunneling of charge carriers between localized states has strong impact on recombination kinetics as well as photoconductivity decay.

1. *Golovynskyi S.L., Mazur Yu.I., Wang Zh.M., Ware M.E., Vakulenko O.V., Tarasova G.G., Salamo G.J.* Excitation intensity dependence of lateral photocurrent in InGaAs/GaAs dot-chain structures // Physics Letters A 378(2014) 2622–2626.
2. *Kondratenko S. V., Vakulenko O. V., Mazur Yu. I., Dorogan V. G., Marega E.Jr., Benamara M., Ware M. E., and Salamo G. J.* Deep level centers and their role in photoconductivity transients of InGaAs/GaAs quantum dot chains // JOURNAL OF APPLIED PHYSICS 116, 193707 (2014).