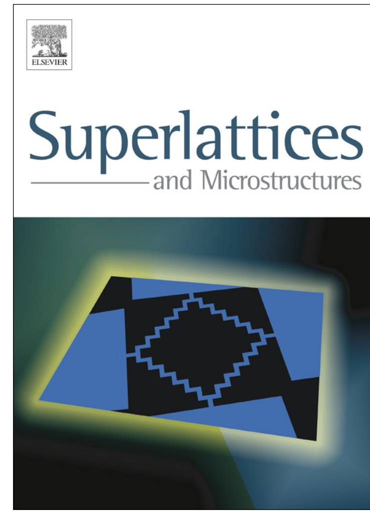
Accepted Manuscript



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PII: S0749-6036(14)00350-4
DOI: http://dx.doi.org/10.1016/j.spmi.2014.09.023
Reference: YSPMI 3419

To appear in: *Superlattices and Microstructures*

Received Date: 14 April 2014
Revised Date: 11 September 2014
Accepted Date: 14 September 2014

The effect of the electronic intersubband transitions of quantum dots on the linear and nonlinear optical properties of Dot-Matrix system

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Linear and nonlinear optical dielectric function of an ensemble of randomly distributed quantum dots (QDs) in host material associated with intersubband transition in QDs are theoretically investigated. In this regard, the electronic structure and (linear and nonlinear) dielectric function of the dots are studied using the effective mass theory and the compact-density matrix approach respectively. Maxwell-Garnett method are used to calculate effective dielectric function of dots-host material medium. The results indicate that, by adding QDs, dielectric constant of host material changes dramatically at frequencies which are corresponding to the intersubband transitions of quantum dots. Also at these frequencies, the dielectric function is strongly size dependent and there is a red shift by increasing the radius of QDs. On the other hand, volume density of quantum dots significantly affect the off-resonant frequencies.

Keywords: Quantum dot, Nonlinear optical property, Maxwell-Garnett method, density matrix approach.

1. INTRODUCTION

In recent years nonlinear optical properties of quantum systems, such as quantum wells, wires and dots, due to the intersubband transitions have been the subject of many studies. After the pioneering studies of Ahn et al, [1] on the nonlinear optical properties of quantum wells, many works have been done on this topic, [2–4]. The motivation is the small energy separation and large dipole moment corresponding to the intersubband transition which causes quantum wells to show extremely large nonlinear optical properties. In most of these works, density matrix approximation has been used to calculate linear and third order nonlinear electric susceptibility. Refractive index and absorption coefficient are the parameters which have been calculated as secondary quantity using the electric susceptibility [5–8].

The dipole matrix element of the optical transition between the subbands of the quantum

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