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<AT>Optical gain of a triple coaxial cylindrical quantum well wires laser under the geometrical effects and magnetic fields

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<ABS-HEAD>Abstract
<ABS-P>In this study, impacts of external magnetic fields and middle layer's size on the optical gain of a coaxial cylindrical quantum well wire laser $GaAs / Al_xGa_{1-x}As / AlAs$ are investigated. By using numerical method, Schrodinger equation are solved and then its optical gain is calculated.
<ABS-P><ST>Results</ST> show that, increasing the middle layer's height leads to blue-shift of the optical gain, and if the middle layer has enough breadth, there is a downfall in it. Otherwise, it remains the same roughly. Also, the max of optical gain and its resonance energy depends considerably on the geometrical size. Additionally, there is a redshift in the optical gain with broadening the layer. Moreover, there are a blue-shift and increase in the optical gain peak by enhancing the magnetic field.
<KWD>Keyword: Optical gain; Quantum well wire laser; Geometrical size; Magnetic field.
<H1>1. Introduction:
Optical gain coefficient is an appropriate factor to describe how operation or optimization of semiconductor optical amplifiers (SOA) or lasers. Nanostructure such as quantum wells (QWs), quantum well wires (QWWs) or quantum dots (QDs) are caused by decreasing dimensions or increasing the quantum confinement which yields narrowing of the gain spectrum and subsequently higher optical gain at a given carrier density [1]. Physical features of nanostructure can be adjusted optionally with tuning the size or shape [2–5], temperature or exposing external perturbations such as external magnetic (electric) field, hydrostatic pressure. Because these yield asymmetry in the potential confinement which change the electron spectra and energy levels of nanostructure [6,7]. Quantum well wires has attracted interest of scientists, due to their merits such as tunability, low-dependence of temperature, lower threshold currents and high optical gain [1,8,9]. Thus, using of QWWs in the gain media of laser and investigating their behavior under different conditions are good way in order to design ideal laser.
A lot of researches about hydrogen impurity, external fields, temperature and pressure effects on the electronic structure, binding energy, absorption coefficient and refractive index in these nanostructures have been reported [7,10–18].
Effects of temperature, pressure, impurity, electric field and size on optical gain of spherical QD with a parabolic and a semi-parabolic potential have been studied in our previous work [19,20]. Moreover, Rasooli et al. [21] and Keshavarz et al. [22], have investigated the gain optimization of the quantum box and Semi-Parabolic QW Laser respectively. Further, effects of magnetic field on optical gain of a PbSe/CdSe QD have been reported, by Saravanamoorthy et al. [23]. Furthermore, effects of geometrical size and magnetic field on optical absorption coefficient and refractive index changes of coaxial cylindrical quantum well wire (CQWW) and multilayer QD have been investigated, by Karimi et al.[24,25]. Therefore, effects of these on optical gain of QWW and CQWW has not been investigated yet.