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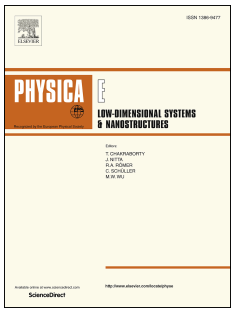

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A double gate resonant tunneling transistor scheme based on Silicene nanotube

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Abstract

In this paper, we propose a scheme of double gate resonant tunneling field effect transistor based on two gates wrapped on a silicene nanotube. By applying a vertical electric field in the side gates, the energy gap in these regions is opened. Due to different bandgap in these regions and other parts of the nanotube, a quantum well is created in the middle which results in confined energy states in the well region. Hence by applying an electric field via lateral gates, we can change the left and right barrier height simultaneously. Moreover, confined states in the well region are tuned by the voltage applied to the central gate. The transmission coefficient of the incident electrons is calculated using the transfer matrix method. Our theoretical results illustrate that the proposed structure has an oscillatory behavior in the transfer characteristics. On the other hand, output characteristic displays a step-like behavior. We also investigate the influence of the barriers and well thicknesses as well as the perpendicular electric field exerted by lateral gates on the current of the proposed device.

Keywords: Electrically induced gap, Resonant tunneling transistor, Silicene nanotube, Transfer matrix.

1- Introduction

Tunneling is a completely quantum mechanical phenomenon which is not defined in the world of classical physics. Although the transmission coefficient or probability of the carriers passing through a barrier is less than one, in the case of a two barriers structure and at some energy levels, the resonance occurs and the transmission coefficient in these energies reaches to its maximum. This