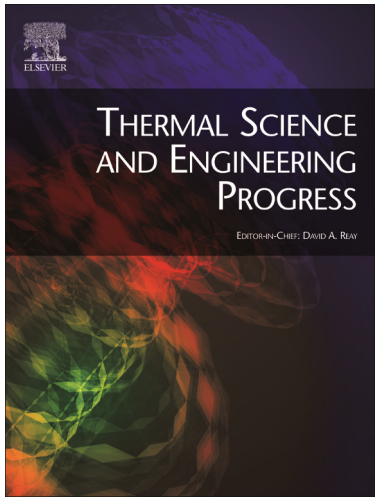

Performance analysis and ecological optimization of an irreversible quantum heat engine with -1/2 spin system

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Performance analysis and ecological optimization of an irreversible quantum heat engine with -1/2 spin system.

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Abstract

This paper is about an irreversible quantum spin-1/2 heat engine. Performance of the irreversible quantum heat engine including basic thermodynamic parameters, power output and energy efficiency, are considered, besides ecological function. Ecological function gives a possibility a comparison between power output and exergy destruction. The results show that power output and ecological function have maximum (optimum) points for different effectiveness values which are 0.9 and 0.8 and according to different magnetic field values . All parameters are compared with each other and it is found that the most convenient operation conditions are obtained at optimum ecological function.

Keywords: quantum heat engine, irreversibility, ecological function, spin -1/2 system.

1. Introduction

Finite time thermodynamics (FTT) began with Curzon-Ahlborn-Novikov engine [1,2]. Purpose of the FTT is to analyze actual heat engines that include irreversibilities. FTT was combined with micro and nano thermal cycles. In last decades, quantum thermodynamics, which investigates heat and work interactions for the quantum mechanical systems, has been gained attention. In the quantum scale, law of the classical thermodynamic cannot be used and quantum mechanical generalization is an obligation in this scale. In addition, nano technology has been increased importantly and thermodynamic evaluation and design of nano systems begin to attract by using quantum thermodynamics. In the literature some examples of quantum heat engines [3-41] or heat pumps and refrigerators [42-65] can be found.

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