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Green functions for photovoltaic response of quantum wire-dot-wire junctions

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Abstract We investigate the photovoltaic properties of a quantum dot connected to quantum wire reservoirs using numerical calculations within the non-equilibrium Green function formalism. We examine impacts of the hopping parameter that controls each dot-wire contact for a monochromatic light at energy equal to the isolated dot gap. Global current increases when the hopping decreases, following the short-circuit current and the open-circuit voltage.

Keywords Quantum dot · Green functions · Photovoltaic · Modeling

1 Introduction

Thanks to intelligent integration of nanoscale structures, new generation of quantum solar cells are expected to exhibit higher efficiency than conventional photovoltaic solar cells (Green 2001). The quantum functioning of such innovative architectures needs to be understood but still very isolated works have been carried out on the subject (Aeberhard 2012). In this work, we rely on a mesoscopic tight-binding model in which quantum dot orbitals replace the atomic orbitals to deeper understand the photovoltaic properties of quantum dots (QD) solar cells. We use the non-equilibrium Green function formalism (NEGF), adapted to studies on open interacting systems (Aeberhard 2011; Aeberhard and Morf 2008). In order to explain quantum solar cell's behavior, a crucial point is to determine the interplay between light absorption and transport and, hence to propose new architectures.

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