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With the Extended Session

QI 2023

Quantum Informatics

Book of

ABSTRACTS

October 2 – 6, 2023

Moscow – Zvenigorod, Russia

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Сборник содержит тезисы докладов, представленных на Международной конференции «Микро- и наноэлектроника – 2023» (ICMNE-2023), включающей расширенную сессию «Квантовая информатика» (QI-2023). Тематика конференции охватывает большинство областей физики микро- и наноразмерных приборов, а также микро- и наноэлектронных технологий, и концентрируется на освещении последних достижений в этой сфере. Она продолжает серию всероссийских (с 1994 года) и международных конференций (с 2003 года).
Ключевые слова: нанотранзисторы, затворные стеки, квантовые компьютеры, МЭМС, магнитные материалы, оптоэлектроника.

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The Book of Abstracts contains the abstracts of the papers presented at the biannual International Conference “Micro- and Nanoelectronics – 2023” (ICMNE-2023) including the extended Session “Quantum Informatics” (QI-2023). The Conference topics cover the most of the areas dedicated to the physics of integrated micro- and nanoelectronic devices and related micro- and nanotechnologies. The Conference is focused on recent progress in those areas. It continues the series of the AllRussian Conferences (since 1994) and the International Conferences (since 2003).
Keywords: nanoscale transistors, gate stacks, quantum computers, MEMS, magnetic materials,optoelectronics.

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Single-electron reservoir network based on single impurity atoms in silicon

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Single impurity atoms devices are being actively developed and studied [1, 2]. Multielectrode single-electron systems with random arrays of impurity atoms in a solid-state matrix (reservoirs) are gaining popularity and are suitable for the implementation of nanoscale neural networks. Reservoir networks based on a disordered array of tunnel-coupled charge centers were created. Reconfigurable logic elements in reservoir networks were demonstrated using tuning [3, 4]. The electrical properties of such systems are determined by the configuration of the impurity atoms charge states. The setting of the system certain functional states is carried out by setting the voltages on the control electrodes, and their search is performed using a genetic algorithm.

In this work we studied the electron transport features in a single-electron reservoir network based on impurity arsenic atoms in silicon. A main singularity of the proposed method for forming a reservoir network is the use of a disordered distribution of impurity atoms in a quasi-two-dimensional near-surface layer of a solid-state matrix based on silicon-on-insulator (SOI) material. The reservoir was a doped region 300 nm in diameter. This region was surrounded by a system of eight tunneling Ti electrodes ~50 nm wide and 15 nm thick. Single-electron transport in the reservoir network was achieved by the separation of impurity centers during the fabrication process.

Studies of the structures were carried out at a temperature of 2.4 K and showed the presence of Coulomb blockade horizontal sections on the current-voltage characteristics in the low-voltage region. The blockade threshold was observed at voltages from tens to hundreds of mV. The observed features of single-electron transport in the structures under study showed the possibility of tuning the network by selecting the voltages on the control electrodes.

The study was supported by the Interdisciplinary Scientific and Educational School of Moscow University “Photonic and Quantum Technologies. Digital Medicine. The equipment of the Lomonosov Moscow State University Educational and Methodological Center for Lithography and Microscopy was used in the work.

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