Defense Technical Information Center
Compilation Part Notice

ADP012746

TITLE: Conductance Quantization in Quasi-2D Electron Systems with Strong Fluctuation Potential

DISTRIBUTION: Approved for public release, distribution unlimited

Availability: Hard copy only.

This paper is part of the following report:

TITLE: Nanostructures: Physics and Technology International Symposium [6th] held in St. Petersburg, Russia on June 22-26, 1998 Proceedings

To order the complete compilation report, use: ADA406591

The component part is provided here to allow users access to individually authored sections of proceedings, annals, symposia, etc. However, the component should be considered within the context of the overall compilation report and not as a stand-alone technical report.

The following component part numbers comprise the compilation report:
ADP012712 thru ADP012852

Conductance quantization in quasi-2D electron systems with strong fluctuation potential

B. A. Aronzon†, D. A. Bakaushin‡, *A. S. Vedeneev*‡, E. Z. Meilikhov†,
and V. V. Ryl'kov†‡

† Russian Research Center "Kurchatov Institute", 123182 Moscow, Russia
‡ Institute of Radioengineering & Electronics RAS, 141120 Fryazino, Moscow reg.,
Russia

We have experimentally shown that some FET-like percolating 2D electron systems (with the length comparable with the percolation correlation length and the width exceeding the latter) based on semiconductor-insulator interfaces (Si/SiO_2, GaAs/AlGaAs, n-GaAs/i-GaAs etc.) with strong electrostatic fluctuation potential (FP) [1] reveal the conductance quantization and drastic decrease in electron localisation degree (in minima of the chaotic potential relief) at elevated temperatures (77–300 K) [2-4]. Estimation of the correlation length has proved that investigated structures of about one micrometer gate length are the real mesoscopic ones.

We have interpreted these effects in terms of the electron transport through some paths corresponding to the percolation level lowered in comparison with the infinite cluster. The resistance of this path is controlled by a single saddle constriction of the chaotic potential relief. When the electron transport through the constriction is ballistic, the structure conductance becomes to be of quantum quasi-1D character.

To construct the physical model of the conductance quantization we have performed a number of computer experiments. Distribution and correlation functions of FP induced in 2D-electron plane by the chaotic ensemble of built-in charges were calculated. As the saddle constrictions determine both the percolation level and the conductance quantization, saddle energy distribution function, negative and positive curvatures' value order, and energy dependence of their averaged ratio were calculated as well. Energy distributions of the percolation levels for mesoscopic structures were also simulated by means of considering the percolation networks of finite sizes.

As a result, we concluded that the physical model considered could qualitatively explain the experiments and predict unusual behaviour of the similar mesoscopic systems caused by the possible strong dependence of the percolation path configuration on electric and magnetic fields.

References

[1] V. A. Gergel' and R. A. Suris, *Sov. Phys. JETP*, **57**, 415 (1983).
[2] B. A. Aronzon, D. A. Bakaushin, N. K. Chumakov, E. Z. Meilikhov, V. V. Ryl'kov, and A. S. Vedeneev, *Proc. Int. Symp. Nanostructures: Physics and Technology*, St.Petersburg, 1997, p. 11.
[3] B. A. Aronzon, D. A. Bakaushin, A. S. Vedeneev, E. Z. Meilikhov, V. V. Ryl'kov *Sov. Physics. Semiconductors*, **31**, 1460 (1997).
[4] B. A. Aronzon, E. Z. Meilikhov, D. A. Bakaushin, A. S. Vedeneev, and V. V. Ryl'kov *JETP Lett.*, **66**, 668 (1997).