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Graphene sensing and thermoelectric devices

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The nanotechnology research nowadays are directed toward many areas which in particular include (i) nanosensors, (ii) digital logic elements, (iii) THz applications, (iv) quantum dots, (v) industrial and automotive applications. At Northwestern we conduct experimental and theoretical research in the area of graphene nano-electronics. Our work at Northwestern is focused on the following topics. (a) Quantum dots as elements of the THz and magnetic field nanosensors. (b) Andreev reflection as a probe of interface properties. (c) Efficient carbon nanotube and graphene thermoelectric nanocoolers and energy generators. Our experimental devices involve multi-terminal graphene and carbon nanotube field effect transistors (G-FET). Such nanoscale devices are utilized to designing of the quantum dot arrays. Resonant character of chiral tunneling and the low inelastic scattering rates serve as reasons why the a.c. current density can be much higher than in ordinary semiconducting devices. By measuring the d.c. current-voltage curves of G-FET quantum dots which are exposed to an external THz field we are able to determine the THz field parameters. In this way we are utilizing the G-FET which actually works as a very sensitive and efficient THz field sensor. Our results suggest that the G-FET setup has a strong potential for designing of the THz sensor arrays, graphene made qubits, and THz lasers. Other potential applications of the G-FET include very efficient nanoscale thermoelectric coolers and the energy co-generators. We conclude that the graphene and carbon nanotube based setups can perform much better than other known devices.

Biography

Serhii Shafraniuk has completed his PhD at the age of 26 years from Kiev State University and postdoctoral studies from Academy of Sciences of Ukraine. He is the Research Associate Professor at Physics and Astronomy Department, Northwestern University, a premier educational and research institution. He has published more than 100 papers in reputed journals and serving as an organizer of various International Conferences.

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