

**Study on interaction between carbon nanotube quantum dots  
and electromagnetic wave**

**Koji Ishibashi**

(RIKEN, Advanced Device Laboratory, Chief Researcher)

**【Outline of survey】**

Carbon nanotube quantum dots, as an artificial atom, have single electron charging energy and zero-dimensional level spacing in a range from submillimeter to THz frequencies. These energy scales can be controlled by gate voltages, which mean that they can interact with electromagnetic wave from microwave to THz frequencies. In this project, we study these interactions as well as developing reliable and reproducible fabrication process of quantum dots in carbon nanotubes. By studying the interactions, we try to manipulate a single spin or a charge with a help of electromagnetic wave. Besides, we try to fabricate sensitive quantum detectors that work in the wide frequency range.

**【Expected results】**

Although the carbon nanotube quantum dots have unique energy scales, the interaction between the electromagnetic wave with the energy and the carbon nanotube quantum dots have not studied yet. Our project will contribute to the basic understanding of the interaction mechanism that can be incoherent and coherent. In the former case, it can be used for the detector that works in a wide frequency range, while in the latter case, it will lead to demonstration of quantum bit. The development of reliable and reproducible quantum dots will serve as a basic technique that may be used for other quantum-dot based nanodevices.

**【References by the principal investigator】**

- S. Moriyama, T. Fuse, M. Suzuki, Y. Aoyagi, K. Ishibashi, “Four-electron shell structures and an interacting two-electron system in carbon nanotube quantum dots”, Phys. Rev. Lett. **94**, 186806 (2005)
- T. Fuse, Y. Kawano, T. Yamaguchi, Y. Aoyagi, K. Ishibashi, “Quantum response of carbon nanotube quantum dots to terahertz wave irradiation”, Nanotechnology **18**, 044001 (2007)

**【Term of project】** FY2007—2011

**【Budget allocation】** 32,600,000 yen  
(2007 direct cost)

**【Homepage address】**

[http://www.riken.go.jp/lab-www/adv\\_device/home.html](http://www.riken.go.jp/lab-www/adv_device/home.html)