

Growth Control of Carbon Nanotube Forest for Electronic and Photonic Devices

Project Leader

FURUTA Hiroshi, Ph.D. Science

Associate Professor, Electronic and Photonic Systems Engineering

Objective

The characteristic electrical, chemical, physical and optical properties of carbon nanotubes (CNTs) are directly derived from their unique structures [1, 2, 3, 4, 5], such as (a) anisotropic electrical conductivity of horizontally aligned CNTs placed on substrates, and (b) anisotropic optical absorption for vertically aligned CNTs grown on substrates. A carbon nanotube forest is a vertically aligned CNT structure grown on substrates means of the chemical vapor deposition. Highly controlled PVD/CVD processes, including self-organization of catalyst particles, are desired to achieve unique highly oriented and periodically positioned CNT forests for new electronic and optronic applications with surprising properties.

Project Outline

Electromagnetic metamaterials[5, 6], composed of CNT forest meta-atoms, will be synthesized from height controlled, highly oriented vertically aligned CNT forests using a photolithography process. To realize the electromagnetic metamaterials, the following items will be developed in this project: (1) structure control of CNTs in diameter (in 1-100 nm) and (2) in growth height (in 10 nm - 10 μ m); (3) the design of an electromagnetic circuit for CNT forest metamaterials, and (4) photolithography process at the electromagnetic scale of 10 - 100 μ m. [5, 6]

References

- [1] "Crystal Structure Analysis of Multiwalled Carbon Nanotube Forests by Newly Developed Cross-Sectional XRD Measurement", H. Furuta, T. Kawaharamura, M. Furuta, K. Kawabata, T. Hirao, T. Komukai, K. Yoshihara, Y. Shimomoto, and T. Oguchi, Appl. Phys. Express 3 (2010)105101.
- [2] "Simulation study of the in-plane type triode carbon nanotube emitter", H. Furuta, K. Ishii, K. Okada, M. Furuta, and T. Hirao, J. Vac. Sci. Technol. B 28(4), (2010) 878-881. (selected paper for the issue of Virtual Journal of Nanoscale Science & Technology, vol22, Issue 7. August 16, 2010)
- [3] "High-density short-height directly grown CNT patterned emitter on glass", H. Furuta, T. Kawaharamura, K. Kawabata, M. Furuta, T. Matsuda, C. Li, T. Hirao, e-J. Surf. Sci. Nanotech. 8(2010)336-339.
- [4] "Stacked Self-standing Carbon Nanotube Forest Films utilizing Periodical Multi-layered (Fe/AlN)_n Films", H. Furuta, H. Koji, T. Harigai and A. Hatta, TechConnect World 2012 (Santa Clara, CA, Jun. 18-22, 2012).
- [5] Web site: <http://hiroshifuruta.wordpress.com>.
- [6] Kakenhi database:<http://kaken.nii.ac.jp/en/p/24560050>

See our admission guidelines:

<https://www.kochi-tech.ac.jp/english/admission/ssp/guideline.html>

Contact

E-mail: furuta.hirorshi@kochi-tech.ac.jp