

【Grant-in-Aid for Scientific Research (S)】
Science and Engineering (Engineering)



Title of Project : Construction of Functionalized Carbon Nano-Materials and Development of Innovative Energy Devices

Shigeo Maruyama
(The University of Tokyo, Graduate School of Engineering,
Professor)

Research Project Number : 15H05760 Researcher Number : 90209700

Research Area : Engineering

Keyword : Carbon Nanotube, Nano-Carbon Materials, Solar Cells, Energy Devices

【Purpose and Background of the Research】

Owing to the energy problems, the attainment of high-efficient and low-cost energy devices is one of the most urgent matters. Recent progress in nanotechnology opens more opportunities for the device fabrication and integration in bottom-up approaches using nano-materials as the building blocks. In this research project, we will develop techniques for the controlled synthesis and functionalization of nano-carbon materials including single-walled carbon nanotubes (SWNTs), graphene and fullerene (schematics in Fig. 1), integrate these materials into various solar cells, and construct innovative energy devices.

【Research Methods】

We will develop the growth techniques of SWNTs and graphene and perform their structure control in the chemical vapor deposition (CVD) growth stage. Additionally, SWNTs and graphene are functionalized in nano- and micro-scale, while fullerene is derivatized through chemical reactions. By using these highly controlled and functionalized nano-carbon materials as “unit materials”, various solar cells, such as organic, hetero-junction and perovskite solar cells, are fabricated. Besides reducing the use of rare metal like indium in conventional devices, we will also construct the innovative energy devices with high efficiency and low cost. An overview of research is shown as Fig. 2.

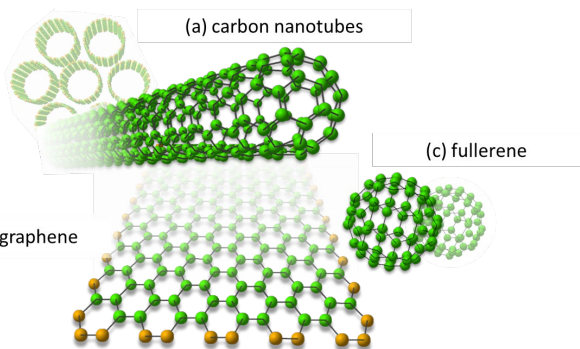


Fig. 1 Nano-carbon materials. (a) SWNT, (b) fullerene and (c) graphene.

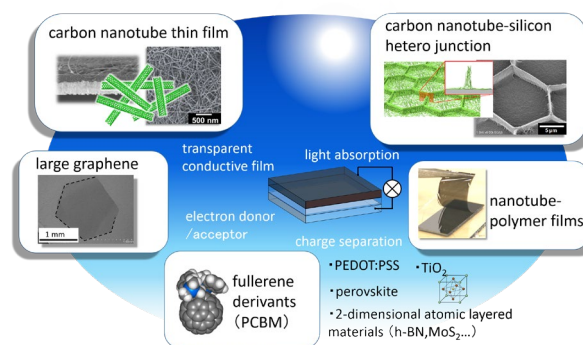


Fig. 2 Nano-carbon energy devices.

【Scientific Significance】

We expect to improve the synthesis and analysis techniques of nano-carbon materials, to elucidate various phenomena in nano-/micro-scale, and to develop nano-carbon based novel energy devices that generate social impact.

【Publications Relevant to the Project】

- [1] K. Otsuka, T. Inoue, S. Chiashi[†], S. Maruyama[†], *Nanoscale*, **6**, 8831-8835 (2014).
- [2] K. Cui, T. Chiba, S. Omiya, T. Thurakitserree, P. Zhao, S. Fujii, H. Kataura, E. Einarsson, S. Chiashi, S. Maruyama[†], *J. Phys. Chem. Lett.*, **4**, 2571-2576 (2013).
- [3] Y. Santo, I. Jeon, K. S. Yeo, T. Nakagawa, Y. Matsuo[†], *Appl. Phys. Lett.* 103 (2013) 073306.
- [4] H. Yanagihara, K. Yamashita, A. Endo, H. Daiguji[†], *J. Phys. Chem. C*, **117**, 21795-21802 (2013).

【Term of Project】 FY2015-2019

【Budget Allocation】 154,100 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.photon.t.u-tokyo.ac.jp/index-j.html>
maruyama@photon.t.u-tokyo.ac.jp

【Expected Research Achievements and