

「プロセスインテグレーションによる機能発現ナノシステムの創製」
平成 20 年度採択研究代表者

H23 年度 実績報告

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自己組織プロセスにより創製された機能性・複合 CNT 素子による柔らかいナノ
MEMS デバイス

§1. 研究実施体制

(1)「畠」グループ

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- ② 研究項目
 1. シート合成技術開発
 2. CNT シートを基板に貼って作るデバイスの製造技術開発
 3. 異材料とのインテグレーション技術開発
 4. 柔らかいデバイス開発

§ 2. 研究実施内容

(文中に番号がある場合は(3-1)に対応する)

2.1 CNTシートを基板に貼って作るデバイスの製造技術開発

2.2 異材料とのインテグレーション技術開発

2.3 柔らかいナノデバイスの開発

§3. 成果発表等

(3-1) 原著論文発表

- 論文詳細情報

1. Dzung Viet Dao, Tung Thanh Bui, Koichi Nakamura, Van Thanh Dau, Takeo Yamada, Kenji Hata, Susumu Sugiyama, Towards highly sensitive strain sensing based on nanostructured materials, *Advances in Natural Sciences: Nanoscience and Nanotechnology*, vol.1, 045012(8pp) (2010), (DOI: 10.1088/2043-6262/1/4/045012)
2. Amano Katsuhiko, Hata Kenji, Muramatsu Shuji, “Arid5a cooperates with Sox9 to stimulate chondrocyte-specific transcription”, *MOLECULAR BIOLOGY OF THE CELL*, vol.22, No.8, pp1300-1311 (2011), (DOI: 10.1091/mbc.E10-07-0566)
3. Takeo Yamada, Yuhei Hayamizu, Yuki Yamamoto, Yoshiki Yomogida, Ali Izadi-Najafabadi, Don N. Futaba and Kenji Hata, “A stretchable carbon nanotube strain sensor for human-motion detection”, *Nature Nanotechnology*, vol.6, No.5, pp296-301 (2011), (DOI: 10.1038/NNANO.2011.36)
4. M. Yamamoto, T. Itoh, H. Sakamoto, T. Fujimori, K. Urita, Y. Hattori, T. Ohba, H. Kagita, H. Kanoh, S. Niimura, K. Hata, K. Takeuchi, M. Endo, F. Rodríguez-Reinoso, K. Kaneko, “Effect of nanoscale curvature sign and bundle structure on supercritical H₂ and CH₄ adsorptivity of single wall carbon nanotube”, *ADSORPTION-JOURNAL OF THE INTERNATIONAL ADSORPTION SOCIETY*, vol.17, No.3, pp643-651 (2011), (DOI: 10.1007/s10450-011-9358-y)
5. Takanori Kihara, Xue-Ying Liu, Chikashi Nakamura, Kang-Min Park, Sung-Woong Han, Dong-Jin Qian, Kazunori Kawasaki, Nikolay A. Zorin, Satoshi

- Yasuda, Kenji Hata, Tatsuki Wakayama, Jun Miyake, “Direct electron transfer to hydrogenase for catalytic hydrogen production using a single-walled carbon nanotube forest”, *International Journal of Hydrogen Energy*, vol.36, No.13, pp7523-7529 (2011), (DOI :10.1016/j.ijhydene.2011.03.135)
6. Ming Xu, Don N. Futaba, Motoo Yumura, and Kenji Hata, “Carbon Nanotubes with Temperature-Invariant Creep and Creep-Recovery from -190 °C to 970 °C”, *Advanced Materials*, vol.23, No.32, pp3686-3691 (2011) (DOI:10.1002/adma.201101412)
 7. Ming Xu, Don N. Futaba, Motoo Yumura and Kenji Hata, “Tailoring Temperature Invariant Viscoelasticity of Carbon Nanotube Material”, *Nano Letters*, vol.11, No.8, pp3279-3284 (2011), (DOI: dx.doi.org/10.1021/nl201632m)
 8. Luca Ceseracciu, Maurizio Bisio, Alberto Ansaldo, Don N. Futaba, Kenji Hata, Alberto C. Barone, Davide Ricci, “Mechanics and actuation properties of bucky gel-based electroactive polymers”, *Sensors and Actuators*, vol.156, No.2, pp949-953 (2011), (DOI: 10.1016/j.snb.2011.03.012)
 9. Satoshi Yasuda, Don N. Futaba, Takeo Yamada, Motoo Yumura and Kenji Hata, “Gas Dwell Time Control for Rapid and Long Lifetime Growth of SWNT Forests”, *Nano Letters*, vol.11, No.9, pp3617-3623 (2011), DOI:dx.doi.org/10.1021/nl201416c)
 10. Ken Mukai, Kinji Asaka, Kenji Hata, Toribio Fernández Otero, and Hideaki Oike, “High-Speed Carbon Nanotubes Actuator Based on Oxidation-Reduction Reaction”, *CHEMISTRY-A EUROPEAN JOURNAL*, vol.17, No.39, pp 10965- 10971 (2011), (DOI: 10.1002/chem.200)
 11. Wei-Hung Chiang, Don N. Futaba, Motoo Yumura and Kenji Hata, “Growth control of single-walled, double-walled, and triple-walled carbon nanotube forests by a priori electrical resistance measurement of catalyst films”, *Carbon*, vol.49, No.13, pp4368-4375 (2011), (DOI: 10.1016/j.carbon.2011.06.015)
 12. Kazufumi Kobashi, Hidekazu Nishino, Takeo Yamada, Don N. Futaba, Motoo Yumura and Kenji Hata, “Epoxy Composite Sheets with a Large Interfacial Area from a High Surface Area-Supplying Single-Walled Carbon Nanotube Scaffold Filler”, *Carbon*, vol.49, No.15, pp5090-509 (2011), (DOI:10.1016/j.carbon.2011.07.028)
 13. Ken Mukai, Kinji Asaka, Kenji Hata and Hideaki Oike, “The performance of fast-moving low-voltage electromechanical actuators based on single-walled carbon nanotubes and ionic liquids”, *SMART MATERIALS & STRUCTURES*, vol.20 ,No.12, 124008(6pp)pp (2011), (DOI: 10.1088/0964-1726/20/12/124008)
 14. Pablo Giménez, Ken Mukai, Kinji Asaka, Kenji Hata, Hideaki Oike, T.F. Otero, Toribio F. Otero, “Capacitive and Faradic Charge Components in High-Speed

- Carbon Nanotube Actuator”, *Electrochimica Acta*, vol.60.,pp177-183 (2012), (DOI: 10.1016/j.electacta.2011.11.032)
15. Shunsuke Sakurai, Hidekazu Nishino, Don N Futaba, Satoshi Yasuda, Takeo Yamada, Alan Maigne, Yutaka Matsuo, Eiichi Nakamura, Motoo Yumura, Kenji Hata, “Role of Subsurface Diffusion and Ostwald Ripening in Catalyst Formation for Single-Walled Carbon Nanotube Forest Growth”, *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*, vol.134, No.4, pp2148-2153 (2012), (DOI:10.1021/ja208706c)
 16. Riko Nishimura, Kenji Hata, Takuma Matsubara, Makoto Wakabayashi and Toshiyuki Yoneda, Regulation of bone and cartilage development by network between BMP signalling and transcription factors, *JOURNAL OF BIOCHEMISTRY*, vol.151, No.3, pp247-253 (2012) , DOI: 10.1093/jb/mvs004
 17. Kentaro Yamato, Ken Mukai, Kenji Hata, Kinji Asaka, Fast-moving bimorph actuator based on electrochemically treated millimeter-long carbon nanotube electrodes and ionic-liquid gel, *International Journal of Smart and Nano Materials*, (DOI:10.1080/19475411.2011.652992 in press)
 18. Don N. Futaba, Hiroe Kimura, Bin Zhao,Takeo Yamada, Hiroyuki Kurachi, Sashiro Uemura, Kenji Hata, “Carbon Nanotube Loop Arrys for Low-Power, High Uniformity Field Emission with Lifetime over 10,000”, *Carbon*, (accepted)

(3-2) 知財出願

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