Growth of carbon nanotubes on stainless steel substrates by DC-PECVD

Duy D.Q., Kim H.S., Yoon D.M., Lee K.J., Ha J.W., Hwang Y.G., Lee C.H., Cong B.T.

Division of Microelectronics and Display Technology, College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea; Regional Innovation Center for Next Generation Industrial Radiation Technology, 208 College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea; Faculty of Physics, HaNoi University of Science, VietNam National University, 334 Nguyen Trai, Thanh Xuan, HaNoi, Viet Nam

Abstract: We report on the fabrication of carbon nanotubes (CNTs) on Ni-coated stainless steel (SUS) substrates by using dc plasma enhanced chemical vapor deposition. The synthesized CNTs have the diameter of about 30 nm and the length of about 1.2 ?m. To verify the effects of SUS substrates on the growth of CNTs, CNTs had also been grown on Ni-coated Si substrates. CNTs grown on the SUS substrates were more uniform compared with those grown on the Si substrates. Field emission properties of the CNT films were measured in the diode configuration, and the turn-on electric field of 3.87 V/?m and field enhancement factor ? of about 1737 were obtained from the synthesized CNTs at the gap of 500 ?m between the SUS substrate and the anode. These results have not only clarified the effects of the substrate on the growth of CNTs, but also shown the potential of CNTs in field emission applications, especially CNT-based cold-cathode X-ray tubes.

Author Keywords: Carbon nanotube; DC-PECVD; Field emission; Pretreatment; SUS

Index Keywords: Chemical vapor; CNT films; DC plasma; Field emission property; Field enhancement factor; In-field; Pre-Treatment; Si substrates; Stainless steel substrates; Turn-on electric field; Carbon nanotubes; Cold cathode tubes; Electric field measurement; Electric fields; Electric properties; Field emission; Field emission cathodes; Plasma deposition; Plasma enhanced chemical vapor deposition; Stainless steel; X ray tubes; Substrates

Year: 2009

Source title: Applied Surface Science

Volume: 256

Issue: 4

Page : 1065-1068

Cited by: 1

Link: Scorpus Link

Correspondence Address: Lee, C.H.; Division of Microelectronics and Display Technology, College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea; email: chlee@wonkwang.ac.kr

ISSN: 1694332

CODEN: ASUSE

DOI: 10.1016/j.apsusc.2009.05.106
Language of Original Document: English
Abbreviated Source Title: Applied Surface Science
Document Type: Article
Source: Scopus
Authors with affiliations:
1. Duy, D.Q., Division of Microelectronics and Display Technology, College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea
2. Kim, H.S., Regional Innovation Center for Next Generation Industrial Radiation Technology, 208 College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea
3. Yoon, D.M., Division of Microelectronics and Display Technology, College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea
4. Lee, K.J., Regional Innovation Center for Next Generation Industrial Radiation Technology, 208 College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea
5. Ha, J.W., Division of Microelectronics and Display Technology, College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea
6. Hwang, Y.G., Division of Microelectronics and Display Technology, College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea
7. Lee, C.H., Division of Microelectronics and Display Technology, College of Natural Sciences, Wonkwang University, Iksan, 344-2 Shinyong Dong, Iksan, Jeonbuk 570-749, South Korea
8. Cong, B.T., Faculty of Physics, HaNoi University of Science, VietNam National University, 334 Nguyen Trai, Thanh Xuan, HaNoi, Viet Nam
References:
1. Iijima, S., (1991) Nature, 354, p. 56
2. Gibson, C.T., Carnally, S., Roberts, C.J., (2007) Ultramicroscopy, 107, p. 1118
3. Robertson, J., (2007) Mater. Today, 10, p. 36
4. Rakhi, R.B., Sethupathi, K., Ramaprabhu, S., (2008) Int. J. Hydrogen Energy, 33, p. 381
5. Kim, H.S., Duy, D.Q., Kim, J.H., Lee, H.J., Yoon, D.M., Shin, S.S., Ha, J.W., Park, C.Y., (2008) J. Korean Phys. Soc., 52, p. 1057
6. Sugie, H., Tanemura, M., Filip, V., Iwata, K., Takahashi, K., Okuyama, F., (2001) Appl. Phys. Lett., 78 (17), p. 2578
7. Hallenbeck, S., (1974) Radiology, 117, p. 1
8. Ribbing, C., Rangsten, P., Hjort, K., (2002) Diamond Relat. Mater., 11, p. 1
9. Rao, A.M., Jacques, D., Haddon, R.C., Zhu, W., Bower, C., Jin, S., (2000) Appl. Phys. Lett., 76 (25), p. 3813
10. Liu, G.Y., Zhong, D.Y., Xia, S.H., Cheng, S.F., Ding, Y.G., Lu, Y.J., Shao, Y.J., Wang, E.G., (2003) Appl. Surf. Sci., 215, p. 209
11. Lee, J.I., Hwang, N.M., (2008) Carbon, 46, p. 1588
12. Arana, C.P., Puri, I.K., Sen, S., (2005) Proc. Combust. Inst., 30, p. 2553
13. Jang, J., Chung, S.J., Kim, H.S., Lim, S.H., Lee, C.H., (2001) Appl. Phys. Lett., 79 (11), p. 1682
14. Teo, K.B.K., Chhowalla, M., Amaratunga, G.A.J., Milne, W.I., Hasko, D.G., Pirio, G., Legagneux, P., Pribat, D., (2001) Appl. Phys. Lett., 79 (10), p. 1534
15. Chapman, B., (1980) Glow Discharge Processes: Sputtering and Plasma Etching, , A Wiley-Interscience Publication

16. Wei, Y.Y., Eres, G., Merkulov, V.I., Lowndes, D.H., (2001) Appl. Phys. Lett., 78 (10), p. 1394
17. Merkulov, V.I., Lowndes, D.H., Wei, Y.Y., Eres, G., (2000) Appl. Phys. Lett., 76 (24), p. 3555
18. Murakami, H., Hirakawa, M., Tanaka, C., Yamakawa, H., (2000) Appl. Phys. Lett., 76 (13), p. 1776
19. Ferrari, A.C., Robertson, J., (2000) Phys. Rev. B, 61, p. 14095
20. Duy, D.Q., Kim, H.S., Yoon, D.M., Kim, J.H., Ha, J.W., Lee, K.J., Hwang, Y.G., Cong, B.T., (2008) J. Korean Phys. Soc., 53, p. 2568
21. Chen, T., Sun, Z., Chen, Y.W., Wang, L.L., Guo, P.S., Que, W.X., (2008) Thin Solid Films, 516, p. 1112