Toetab TÜ ja TTÜ doktorikool
"Funktsionaalsed materjalid ja tehnoloogiad" (FMTDK)

ESF projekt 1.2.0401.09-0079

PREPARATION AND CHARACTERIZATION OF DIELECTROPHORETIC CARBON NANOTUBE FIBERS

Margo Plaado, Kristjan Saal, Rünno Lõhmus, Ilmar Kink, Ants Lõhmus.
Institute of Physics, University of Tartu, Riia 142, 51014, Tartu, Estonia.
e-mail: plaado@fi.tartu.ee

Carbon nanotubes (CNT`s) are extraordinary materials due to their several superior properties like ultra-high strength (~150 GPa), Young's modulus (~1 TPa), chemical stability, and thermal and electrical conductivity [1,2]. High aspect ratio (up to 10^6) makes CNT-s very promising for a wide variety of technological applications, like nanoelectronics, nanooptics, NEMS, advanced materials, etc.

Despite their high technological potential, the utilization of CNT's in technologies has remained problematic because of the lack of suitable manipulation methods. For example, the preparation of CNT composites has often run into difficulties in homogenizing the tubes in the matrix material. However, certain manipulation strategies, like dielectrophoresis [3,4], have been proven effective.

Here we report the mechanical and electrical properties of CNT fibers prepared by dielectrophoresis method. Our experimental set-up enables to vary the essential preparation parameters like concentration of CNT solution, drawing speed, operational voltage and frequency. Different precursor properties were varied and tested for their contribution to the important fiber characteristics like density, tensile strength, Young's modulus, and conductivity.

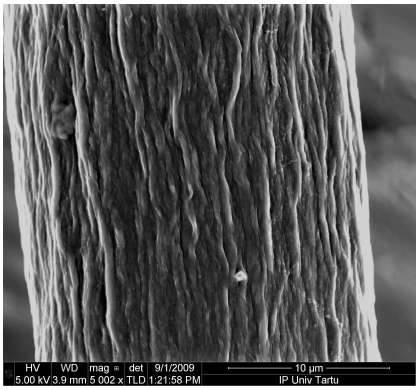

Fig. 1. SEM image of dielectrophoresis grown CNT fiber.

Typical as-grown fibers show the following characteristics: diameter 1–200 µm, length up to 10 cm, density 0.2–0.5 g/cm^3, tensile strength up to 150 MPa, Young's modulus 5,5 GPa, and resistivity $8 \cdot 10^{-3}$ Ohm·cm.

This work was supported by the Eurocores Fanas Nanoparma Program and the Estonian Nanotechnology Competence Center.

References

[1] B. G. Demczyk, Y. M. Wang, J. Cunnings, M. Hetman, W. Han, A. Zettl, R.O. Richie, *Mater. Sci. Eng. A* 2000, 334, 173-178.
[2] M. F. Yu, B. S. Files, S. Arepalli, R. S. Ruoff, *Phys. Rev. Lett.* 2000, 84, 5552-5555.
[3] H. W. Lee, S. H. Kim, Y. K. Kwak, C. S. Han, *Rev. Sci. Instrum.* 2005, 76, 046108.
[4] J. Tang, B. Gao, H. Z. Geng, O. D. Velev, L. C. Qin, O. Zhou, *Adv. Mater.* 2003, 15, 1352-1355.