Formation of thick dielectrophoretic carbon nanotube fibers

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The development of carbon nanotube (CNT) fiber technologies is motivated by the promise of obtaining thread-like micro- and macro-scale structures that carry a significant fraction of the extraordinary mechanical and electrical properties of individual CNTs. In the case of dielectrophoresis (DEP), the fiber is drawn from a CNT suspension with an ultrasharp metal needle while applying an AC voltage between the needle and the substrate where the suspension droplet rests [1].

The aim of this work was to elucidate the formation process of dielectrophoretic carbon nanotube fibers (CNT-fibers) and characterize the fiber properties relevant to their technological applications. The fiber diameter was shown to increase when applied voltage was increased (up to 350 Vpp) and when retraction speed was decreased (down from 400 μm s^{-1}) in accordance with theoretical expectations. This work represents the first demonstration of the formation of thick DEP CNT-fibers (up to 0.4 mm in diameter). This is an intriguing result, as it expands the diversity of possible applications of the fibers and facilitates their characterization by analytical methods that require large quantities of the material.

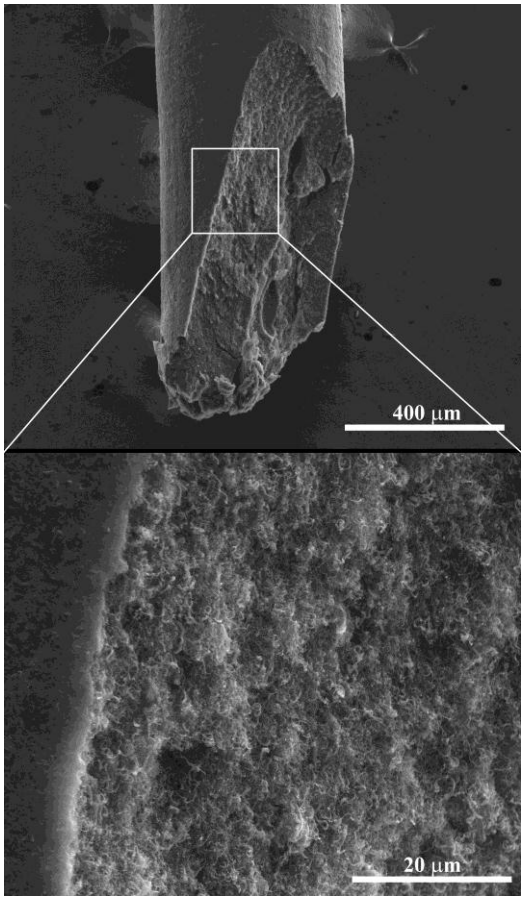

Fig. 1. SEM image of dielectrophoresis grown CNT fiber.

The performance of these thick fibers was as follows: a density of ~0.35 g cm^{-3}, a tensile strength of ~15 MPa, a Young's modulus of ~1 GPa, and an electrical resistivity of ~70 mΩ cm [2].

Acknowledgements

This work was supported by the Estonian Science Foundation grant no 8420, 8428, Eurocores Fanas Nanoparma Program, Estonian Nanotechnology Competence Center and by graduate school „Functional materials and processes" receiving funding from the European Social Fund under project 1.2.0401.09-0079 in Estonia.

References:

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[2] Plaado M, Mononen R M, Lõhmus R, Kink I and Saal K 2011 *Nanotechnology* **22** 305711