Aalto University

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Carbon nanotubes synthesized from liquid precursors

Title of the dissertation	Gas-phase synthesis of single-walled carbon nanotubes from liquid carbon source for transparent conducting film applications
Contents of the dissertation	The transparent conducting films (TCFs) comprising of single-walled carbon nanotubes (SWCNTs) have various applications like solar cells, touch screens, organic light-emitting diodes, and thin-film transistors (TFTs). Particularly, the SWCNT TCFs on a polymer substrate can maintain their properties well under mechanical bending and stretching. Thus, high-yield production of SWCNTs with desired morphological and structural features for the fabrication of highly conductive TCFs is of significance for their scaled-up applications. As for the representative application of SWCNTs in TFTs, semiconducting-enriched SWCNTs (s-SWCNTs) are preferable. This dissertation focuses on the high-yield production of SWCNTs for conductive film applications and the synthesis of s-SWCNTs. A dedicatedly designed aerosol reactor was constructed for SWCNT synthesis using liquid hydrocarbons (i.e., ethanol, toluene) as the carbon source injected with a syringe pump. Additionally, the roles of sulfur in the growth of SWCNTs were explored. By selecting toluene as the carbon source, SWCNT TCFs exhibiting the sheet resistance of ca. 57 Ω/sq at 90% transmittance at 550 nm were fabricated with high yield. High-purity s-SWCNTs were also continuously produced with ethanol as the carbon source and methanol as a growth enhancer. The s-SWCNT purity determined from the optical absorption spectrum can be higher than 95%. The studies presented in the dissertation have laid a solid foundation for the industrial-level production and applications of SWCNTs and SWCNT TCFs.
Field of the dissertation	Engineering Physics
Doctoral candidate	Erxiong Ding, M.Sc.
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Custos	Professor Esko I. Kauppinen, Aalto University School of Science, Department of Applied Physics
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