

Press release

Public Defence on 13 January 2023

Advancing carbon nanotube-based transparent electronics

Title of the doctoral thesis	Fine-Tuning of Single-Walled Carbon Nanotube Properties for Transparent Conductive Applications
Content of the doctoral thesis	<p>Carbon nanotubes are a class of one-dimensional carbon allotropes capable of revolutionizing modern technology thanks to their unique physical properties. With the modern paradigm shifting towards foldable and stretchable devices, transparent and conductive films of single-walled carbon nanotubes (SWCNTs) are prominent materials for next-generation display technology. In fact, highly flexible and stable films based on nanotubes outperforms brittle metal-oxides –commonly used transparent electrode material – provided they reach the same electrical performance and are efficiently produced at large scale. Thus, optimization of transparent conductive properties of nanotube films and improvement of the synthesis productivity are the critical steps for their ubiquitous applications in electronics.</p> <p>Current work is focused on developing approaches for the efficient synthesis of single-walled carbon nanotubes and optimizing the transparent conductive characteristics of their films. For this, two distinct reactor systems were thoroughly investigated, addressing the effect of synthesis conditions on SWCNT structure, and associating them with the conductive properties of films. In terms of the thesis, reactor engineering for carbon nanotube synthesis is actively discussed. For experimental data processing, advanced machine learning methods are implemented, resulting in efficient tuning of SWCNT transparent conductive characteristics. Besides, the thesis comes up with a novel and reversible method for post-synthesis enhancement of the electrical conductivity of the films.</p> <p>The main outcome of this research lies in establishing routes for the highly-efficient production of single-walled carbon nanotube films with competitive transparent conductive characteristics, surpassing the previous advancement in the field. The results of the thesis are believed to be of high importance for the commercial fabrication and processing of single-walled carbon nanotube films and also indicate a direction for further development of nanotube synthesis approaches driven by advanced data analysis.</p>
Field of the doctoral thesis	Physical Chemistry
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Place of public defence	Aalto University School of Chemical Engineering, Lecture hall Ke2 (Komppa-Sali), Kemistintie 1, (main door at Biologinkuja) Espoo
Opponent(s)	Professor Dr. Ralph Krupke, Karlsruhe Institute of Technology, Germany
Custos	Professor Tanja Kallio, Aalto University School of Chemical Engineering

Link to electronic thesis

<https://aaltodoc.aalto.fi/handle/123456789/51>

Keywords

single-walled carbon nanotubes; floating-catalyst chemical vapor deposition;
transparent conductive films.