Substrate Preparation Using Mineral Nanoplates for Synthesizing Carbon Nanotube Arrays

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Vertically-Aligned CNT Array

Membranes
Supercapacitors
Super hydrophobic surfaces
“Gecko” tapes
Li ion batteries
Polymer-nanotube composites
Field emission sources
Synthesis: Chemical Vapor Deposition

$C_2H_2 \xrightarrow{\text{C}} C$

Diagram showing the process of chemical vapor deposition, starting with acetylene ($C_2H_2$) and ending with carbon nanotubes.
Hero behind the Scene: Al$_2$O$_3$ Buffer
Importance of $\text{Al}_2\text{O}_3$ Buffer Layer

Buffer

No Buffer

500 µm

2 µm
Our Method for Buffer Preparation

- 7 nm γ-AIOOH Nanoplates
- Layer-by-Layer Assembly (LBL)
- Annealing

H₂O

PEI (Polyethylenimine)

PAA Poly(acrylic acid)
Boehmite ($\gamma$-AlOOH) Nanoplates

Aluminium Isopropoxide

$\xrightarrow{\text{Hydrolysis}}$ Amorphous AlOOH

$\xrightarrow{\text{Hydrothermal}}$ Boehmite (γ-AlOOH) Nanoplates
Formation of $\gamma$-$\text{Al}_2\text{O}_3$ after Annealing

50 nm

$\gamma$-$\text{Al}_2\text{O}_3$

$\gamma$-$\text{AlOOH}$

Si
Control of $\gamma$-$\text{Al}_2\text{O}_3$ Buffer Thickness

![Image of 500 nm and 200 nm thicknesses]

![Graph showing thickness vs. LBL cycles]

Thickness (nm)

LBL Cycles

500 nm

200 nm
CNT Arrays More Than 1 mm Long

- 500 µm
- 1 µm
- 50 nm
- 10 nm
Mineral Nanoplates Serve as Both Buffer and Catalyst for Growing CNT Arrays
Summary

Mineral nanoplates are reliable and versatile precursors for preparing substrates to be used for synthesizing carbon nanotube arrays.

Substrate preparation using mineral nanoplates are scalable, energy-conservative, rapid, and simple.
