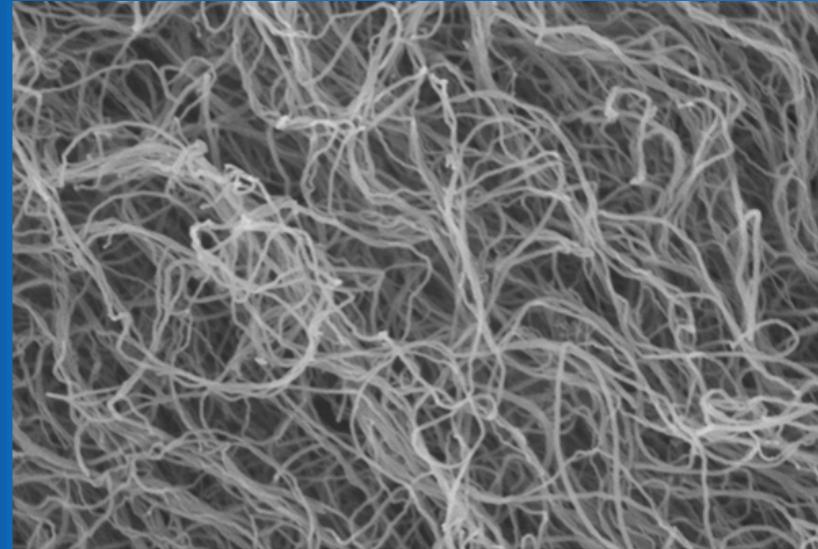
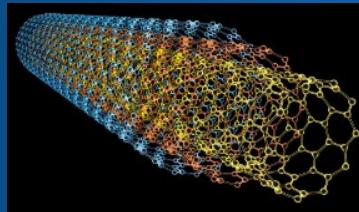


# Manufacturing Carbon Nanotubes at Gigafactory Scale

Hari K Harikumar  
CHASM Advanced Materials  
Massachusetts , USA  
[www.chasmtek.com](http://www.chasmtek.com)



# Introducing CHASM Advanced Materials, Inc.

**Our mission is to develop and manufacture advanced carbon nano materials, leveraging our innovative product platforms to create a safer, more connected and sustainable world.**

## CHASM SOLUTION PLATFORMS



Reinforcing Additives for sustainable concrete and Conductive Additives for better Lithium-ion batteries



BETTER BATTERIES



Transparent Heaters for reliable ADAS sensors and Transparent Antennas for 5G, IoT and beyond



Ultra-permeable RO Membranes with high selectivity for residential and industrial water purification



## LEADERSHIP TEAM

Experienced and talented team in place to accelerate growth



**David Arthur**  
Co-Founder and Chief Executive Officer

- 35+ years experience in executive leadership roles. Prior companies include Rogers Corp, A.T. Cross, TPI Composites, Helix Technology Corp, and Eikos Inc. Holds BS in Chemical Engineering from Tufts, MS in Chemical Engineering from the Univ. of Connecticut and MBA from Northeastern University.
- Recognized by Nano Business Alliance as one of the top ten most influential people in the field of Nanotechnology and is an inventor with more than 30 patents.



**Bob Praino**  
Co-Founder and Chief Innovation Officer

- 40+ years of experience commercializing and developing products and advanced manufacturing processes. Prior companies include Stone & Webster, Polaroid, Presstek, Vitex Systems, and Precision Lithograining. Holds BS and MS in Chemical Engineering from WPI and MBA from Boston University.
- Global expert in R2R manufacturing, including interfacial science and process design. Holds SEMI-FlexTech FHE Governing Council Chair and 2022 Environmental Sustainability Champion.



**Dr. Ricardo Prada Silvy**  
CTO



**David Rainey**  
CFO



**Ina Jiang**  
VP Marketing



**Dr. Hari Harikumar**  
VP Advanced Carbons



**Dan Skiba**  
VP Printed Electronics



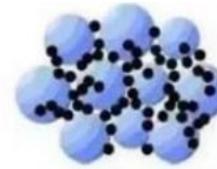
# Appearing Now In Li-ion Batteries: Carbon Nanotubes!

## 3.4 Carbon nanotubes: 4680 battery helps improve the permeability of carbon nanotubes

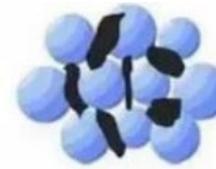
### 3.4.1 The performance of carbon nanotubes is superior, and the permeability of carbon nanotubes is promoted by the 4680 battery

As the key auxiliary material of power battery, conductive agent can increase the conductive contact between active substances, ~~improve the transmission ratio of electrons in the electrode of lithium battery, so as to~~ improve the rate performance of batteries requires a mixed ion metal to improve discharge, the reduced, the gap is so it is also in the cycle amount of current between the active substances and between the active substances and the collector fluid, so as to reduce the contact resistance of the electrode and accelerate the movement rate of electrons.

A blog post published on the Tycorun web page describes why CNTs are a preferred conductive carbon additive.



Super P



Synthetic Graphite



Carbon Nanotubes

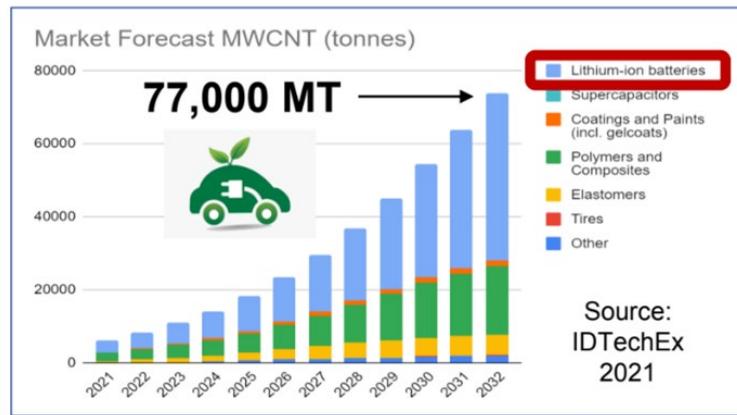


Graphene

*“Nanotubes allow using less material to get the same conductivity enhancement as larger amounts of carbon black. The carbon nanotubes also enable a more robust structure.”*

CNTs are known to boost Li-ion battery performance with:

- **Excellent electrical conductivity,**
- **Longer cycle life** due to high structural strength & toughness,
- **Better heat dissipation** during charging and discharging,
- **Improved charge rate performance** and
- **Improved energy density.**

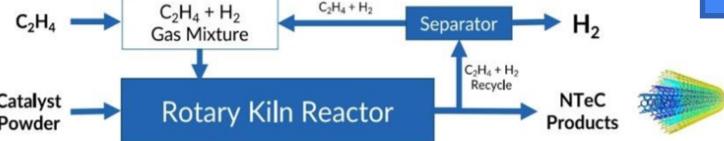


...and mass market adoption of CNTs is on the verge of **explosive growth.**

# SMW300X: Made in USA with the Right Specifications

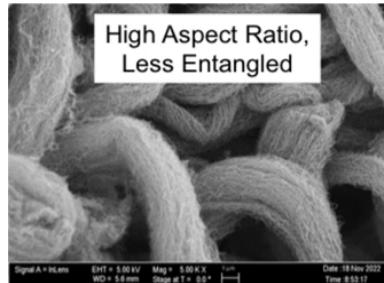
## Lowest Cost, Most Scalable Production

### 1 Continuous Production Platform



Leveraging capital efficient and scalable Rotary Kiln Reactor compared to traditional Fluidized Bed Reactors

### 2 'Drop-in' MWCNT



### 3 Easy to Disperse

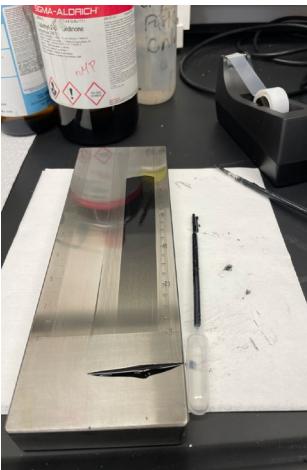


## SMW300X Beats all Specifications

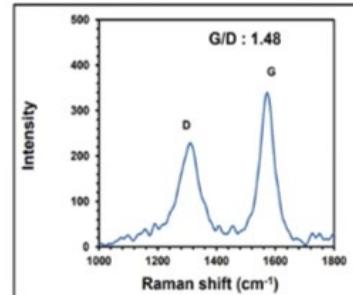
- Drop-in replacement for industry standard LiB MWCNTs
- High CNT purity (> 99%)
- Metal impurity is Cobalt (no iron)
- Median Outer Diameter = 10nm
- Optimal Length after Dispersion (~2
- Low CNT defects (G/D = 1.48)
- High Specific Surface Area (303 m<sup>2</sup>/g)

Drop-in dispersion for existing processes

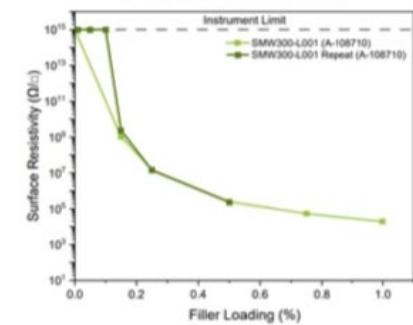
# SMW300X: The Proof Is In...The Performance Data



Low CNT Defects



Low Percolation



Performance of CHASM's SMW300X has been validated by multiple 3rd parties.  
Currently in talks with 3 Gigafactory Operators.

# The Scalability Journey to the World's largest CNT production platform



## Generation 2

Capacity: 7 kg/day  
2019



## Generation 3

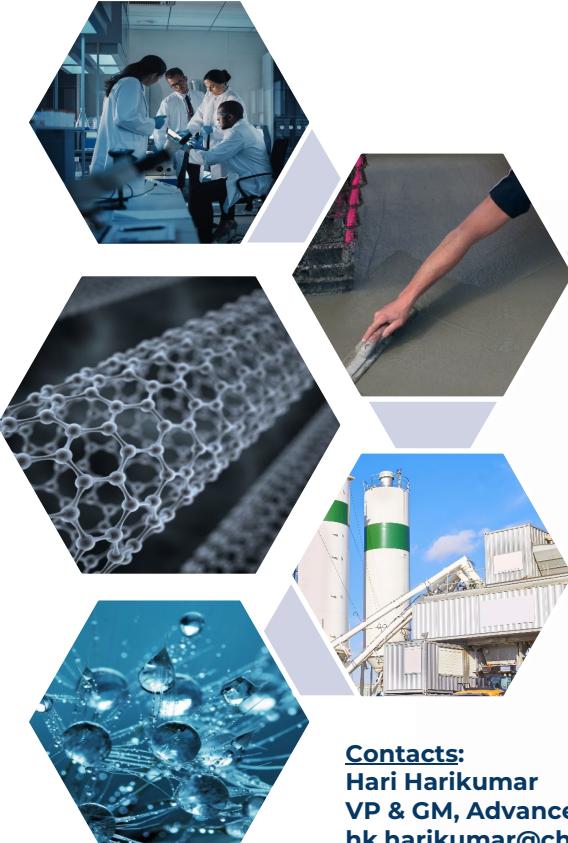
Capacity: 50 MTA  
2022 in Norman OK



## Generation 4

Capacity: 1500 MTA  
H2 2024  
(World's Largest CNT Unit)

# Thank You!



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