



Carbon Nanotubes Manufacturing & Applications

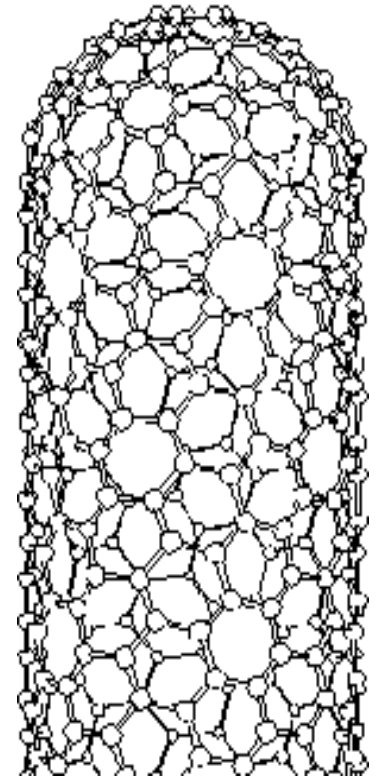
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2013 Nano
Manufacturing
Summit,
Philadelphia,
16 Oct. 2013



Carbon Nanotubes (CNT)

- Disruptive Technology!
 - Hollow, Tubular “1D” Carbon
 - Nano size (as small as DNA)
 - World’s Strongest Material
 - Better Conductor than Copper
 - Better Semiconductor than Silicon
 - Extremely Stable
 - Heat, Radiation, Moisture, Chemicals, etc.



Our Mission:
*Make High Quality CNTs
Affordable & Abundant*

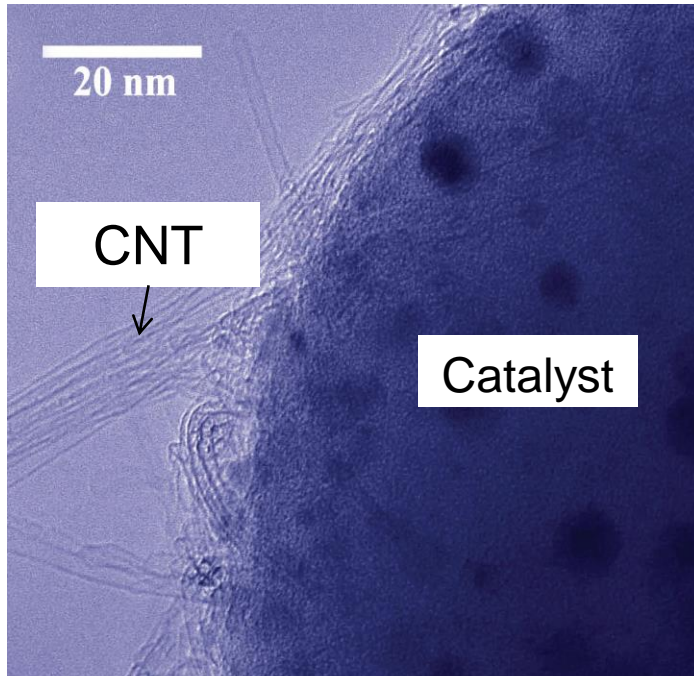




- Founded in 2001.
- Spinout of OU & NASA.
- 20 employees, based in USA
 - Production Plant and R&D in Norman, OK
 - Applications Dev. and Sales in Boston, MA
- World’s Best CNT manufacturing technology:
 - Quality Control (structure & purity) & Scalability
- Full range of CNT types (SW, FW, MW)
- Only US manufacturer with EPA approvals for commercial-scale production of SW, FW, MW.
- “Standard Reference Material” (NIST)

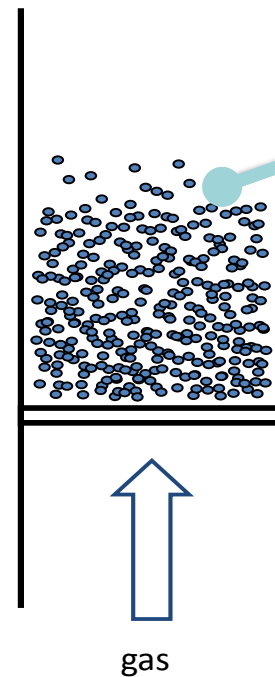
CNT Synthesis

> 30 Issued Patents



CoMoCAT®
Supported Catalyst

Fluidized Bed
(Inherently Scalable)



Uniform
Heat
and
Mass
Transfer

Catalyst = “Secret Sauce”

Production Plant



CNT Production Plant in
Norman, OK – built in 2008



CCVD Fluidized Bed
Reactors (4)

CoMoCAT®

SMW™

SW

“Single-wall”

Feed: CO
Support: SiO₂

FW

“Few-wall”

Feed: CH₄
Support: MgO

MW

“Multi-wall”

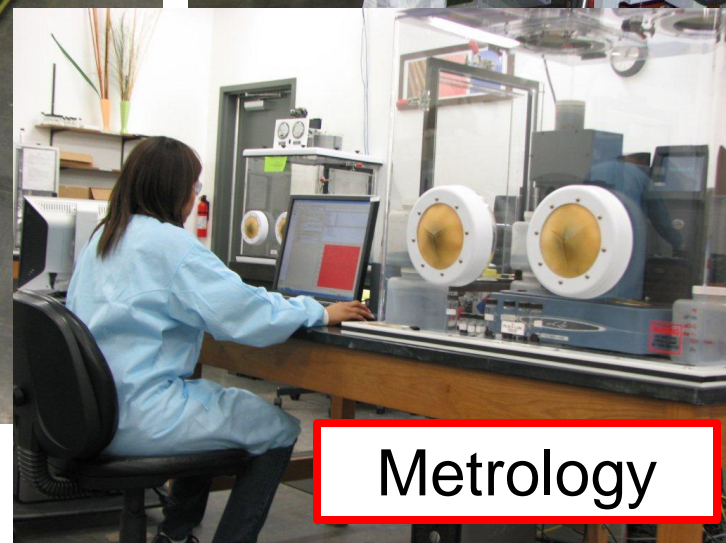
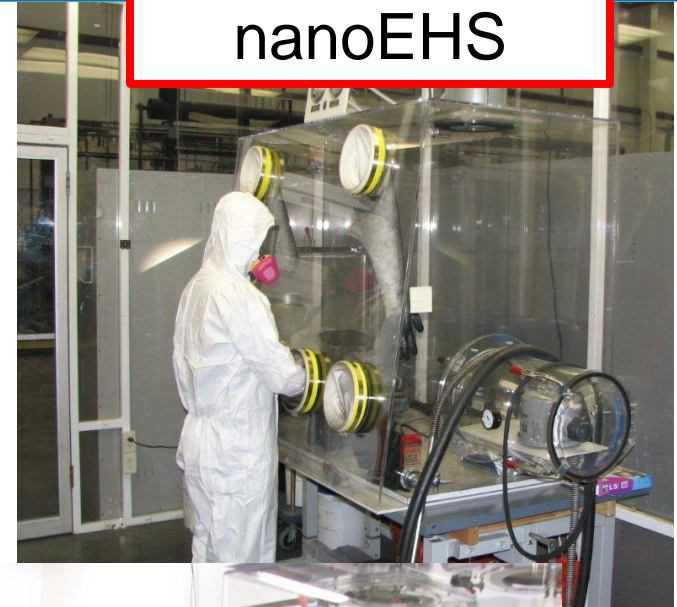
Feed: C₂H₄
Support: Al₂O₃

Production (cont'd):

Industrial Scale Purification



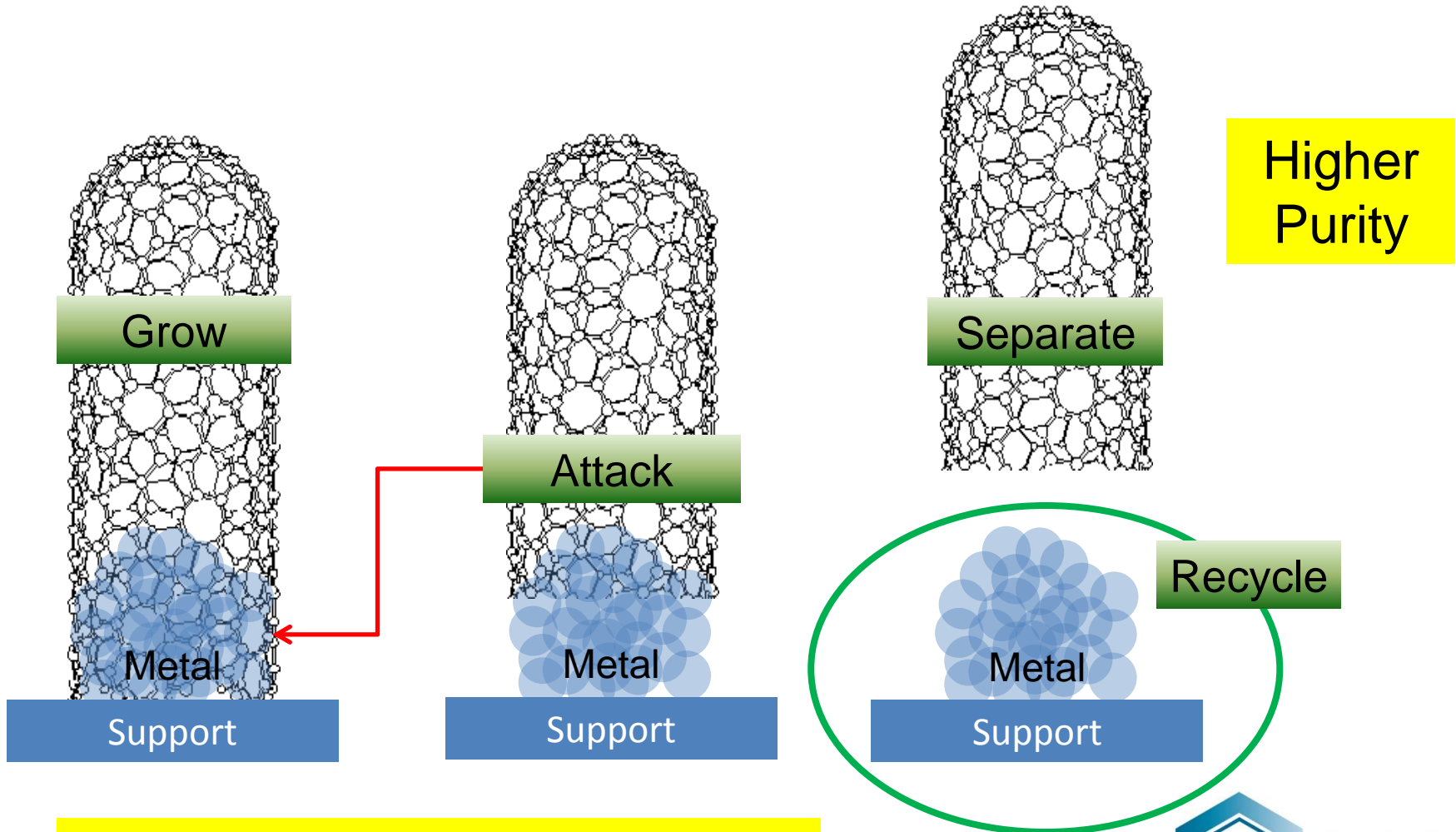
nanoEHS



Metrology

CNT Harvest™

Patents Pending



Lower Cost, Greener Process



“Our mission is to help our clients commercialize new products through smart application of material science and process technology”

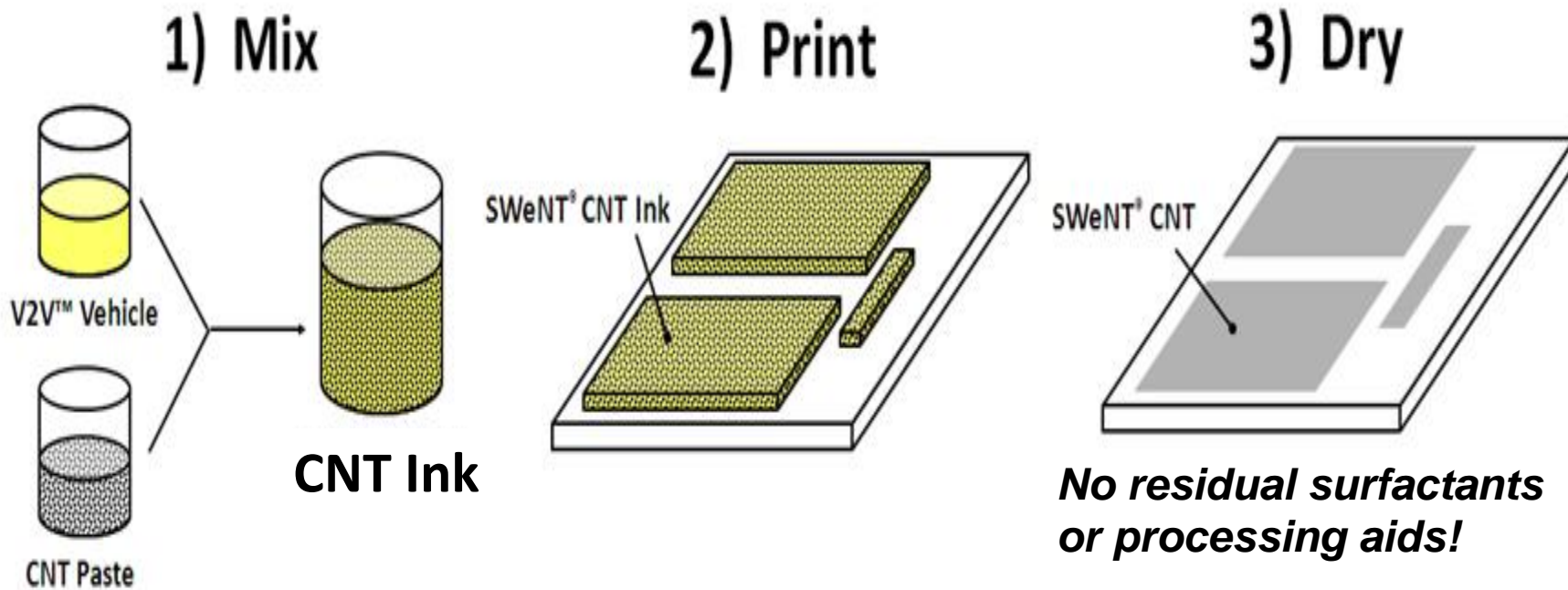
SWeNT Strategic Alliance Partner



SWeNT’s Business & Applications Development Function is co-located with Chasm in the Boston, MA area.

V2V™ Inks

Patents Pending



CNTs can be printed using Standard Industrial Printing Equipment



MWCNT Pastes & Dispersions (without Surfactant!)

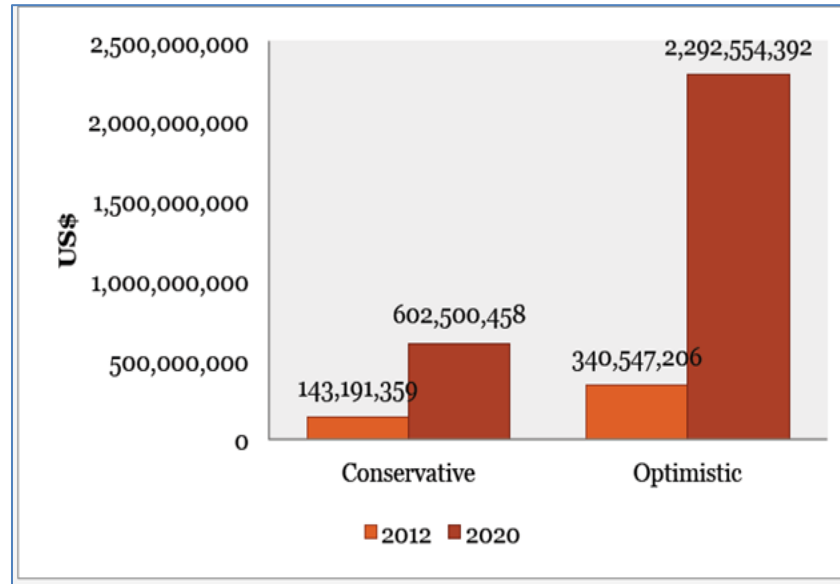
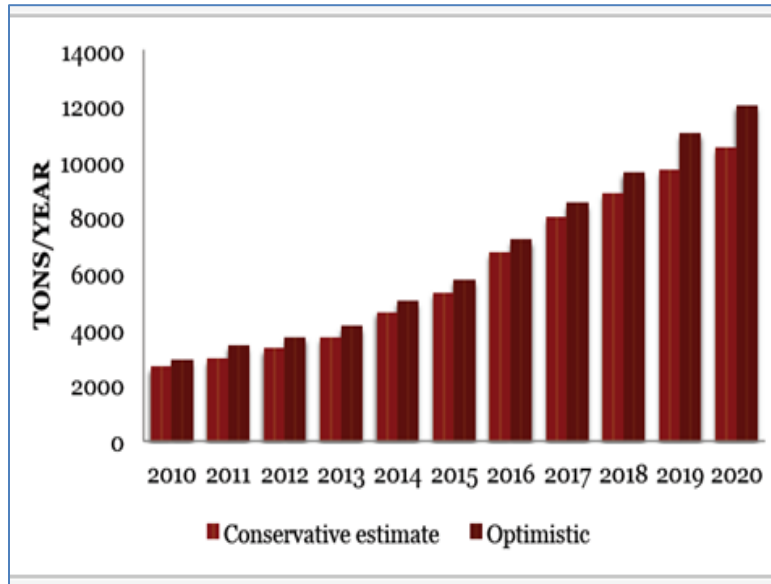


SMW200SX-AP
Aqueous Paste, ~ 5 wt% CNT

SMW200SX-AD
Aqueous Dispersion, ~ 1 g/l

Patents Pending

“The market for Carbon Nanotubes is expected to grow to > 10,000 MTA and reach annual sales of \$600 million to \$2.3 billion by year 2020”



* The difference between Conservative & Optimistic forecasts for Market Value is sales of **“higher-value”** CNTs, such as SW and FW.

Source: Future Markets

CNT Applications



Build partnerships to improve chiral purity & develop applications

	SW	FW	MW
Polymer Composites			N
Energy Storage		N	N
Optoelectronics	N	F	
Carbon Fiber	F	F	
Metal Matrix Composites	F		F
Water Purification	F		
Construction Materials			F

N = Now

F = Future

Build partnerships to expand capacity, reduce cost & expand distribution



Thank you!