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Nanomanufacturing Summit 2012



*Hi Quality,
Affordable
Single-wall
& Multi-wall
Carbon
Nanotubes*

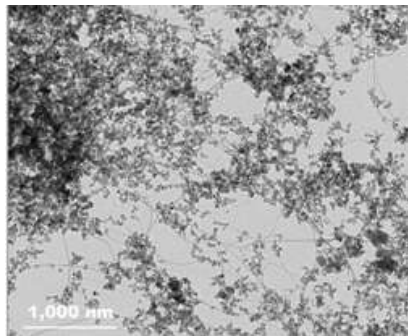


Made in USA

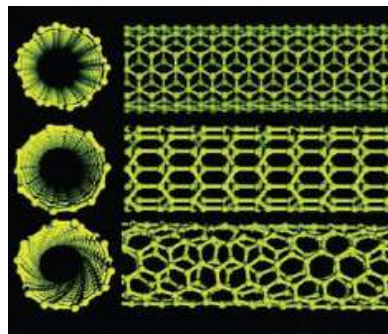


Baseline Solutions

- Single-wall CNT



< 50% SWCNT



~ 67% sc-SWCNT

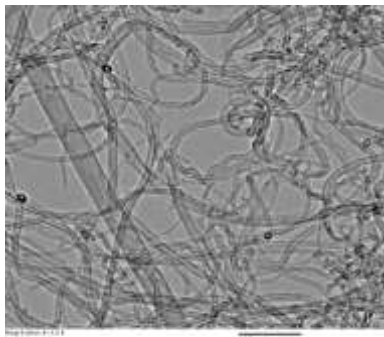
Unmet Market Need:

- High Purity
- Chirality Control
- Low Cost

- Multi-wall CNT



Morphology



Defects

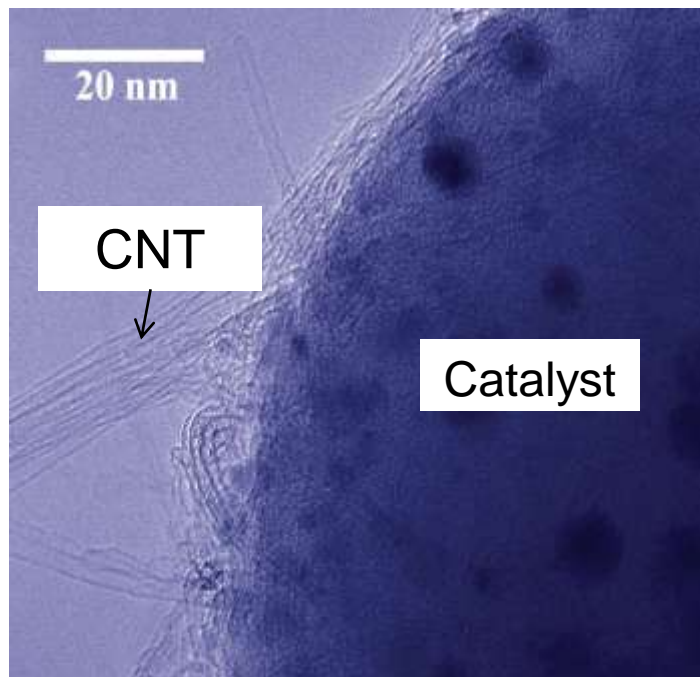
Unmet Market Need:

- Easy to Disperse
- High Conductivity @ Low wt% CNT

Innovative Solution (Part 1)

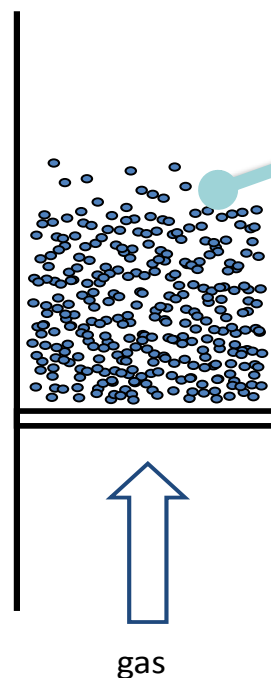
CoMoCAT®

30 Issued Patents



Supported Catalyst
(Selective Synthesis)

Fluidized Bed
(Inherently Scalable)

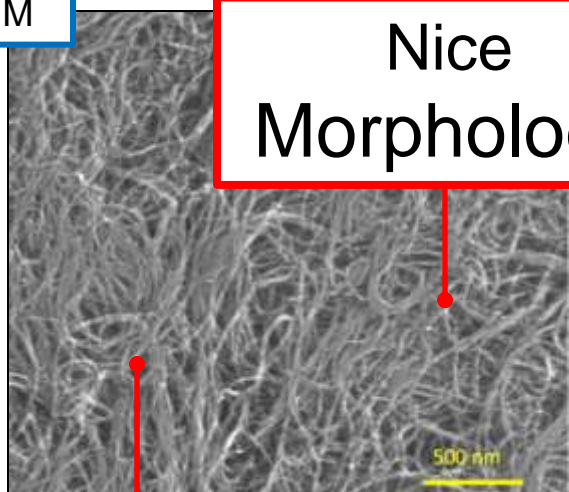


Uniform
Heat
and
Mass
Transfer

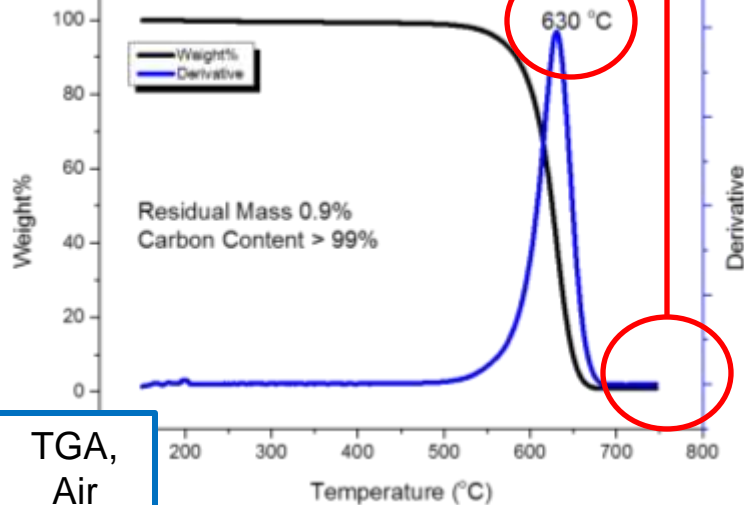
Multi-wall CNT

SEM

Nice
Morphology

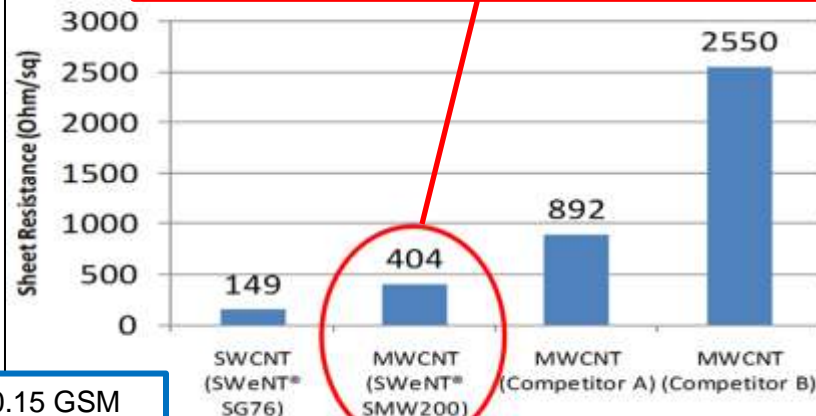


High Purity



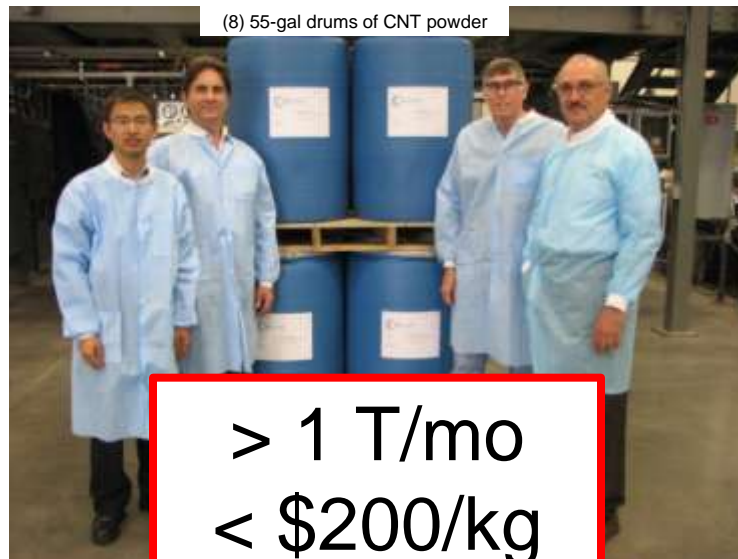
TGA,
Air

High Conductivity



0.15 GSM
buckypaper

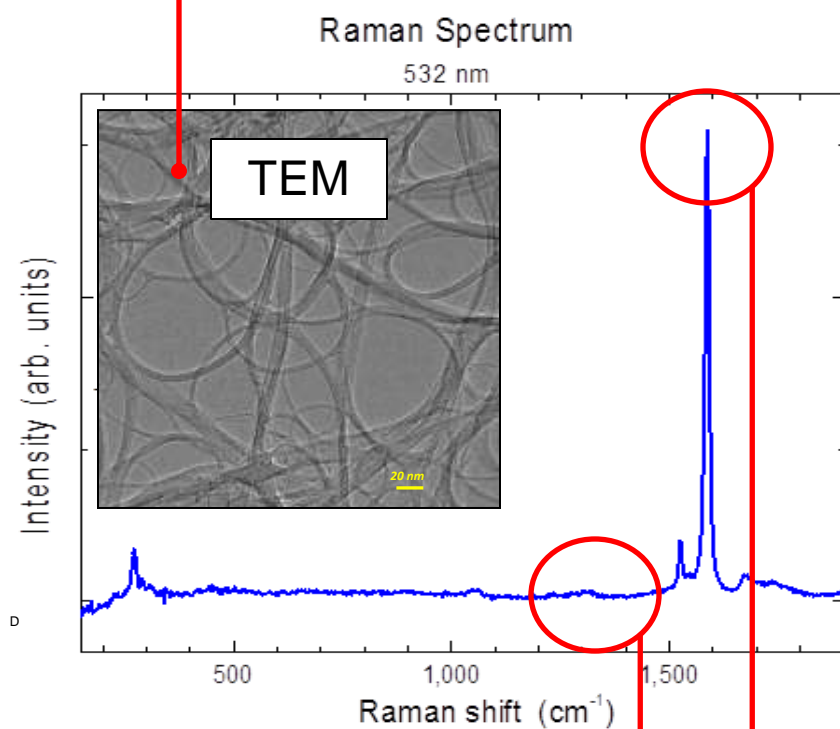
(8) 55-gal drums of CNT powder



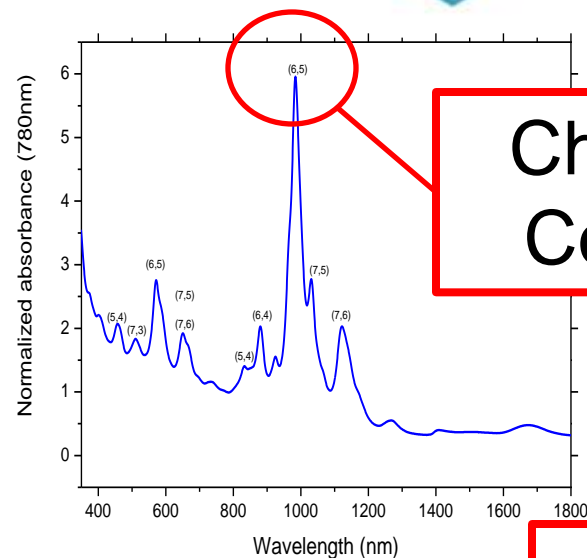
> 1 T/mo
< \$200/kg

Single-wall CNT

High Purity



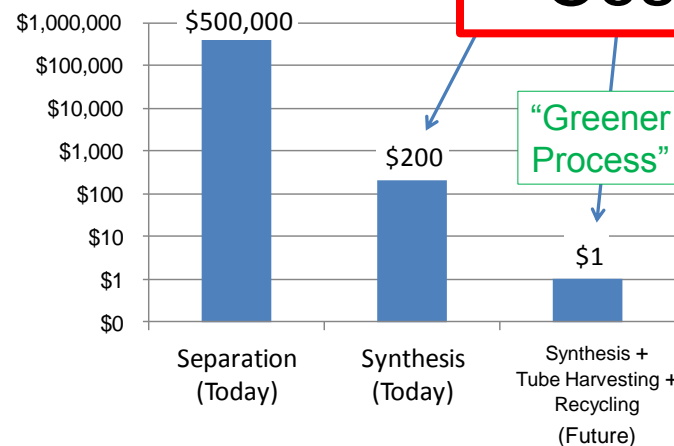
Low Defects



Chirality Control

Price per gram:

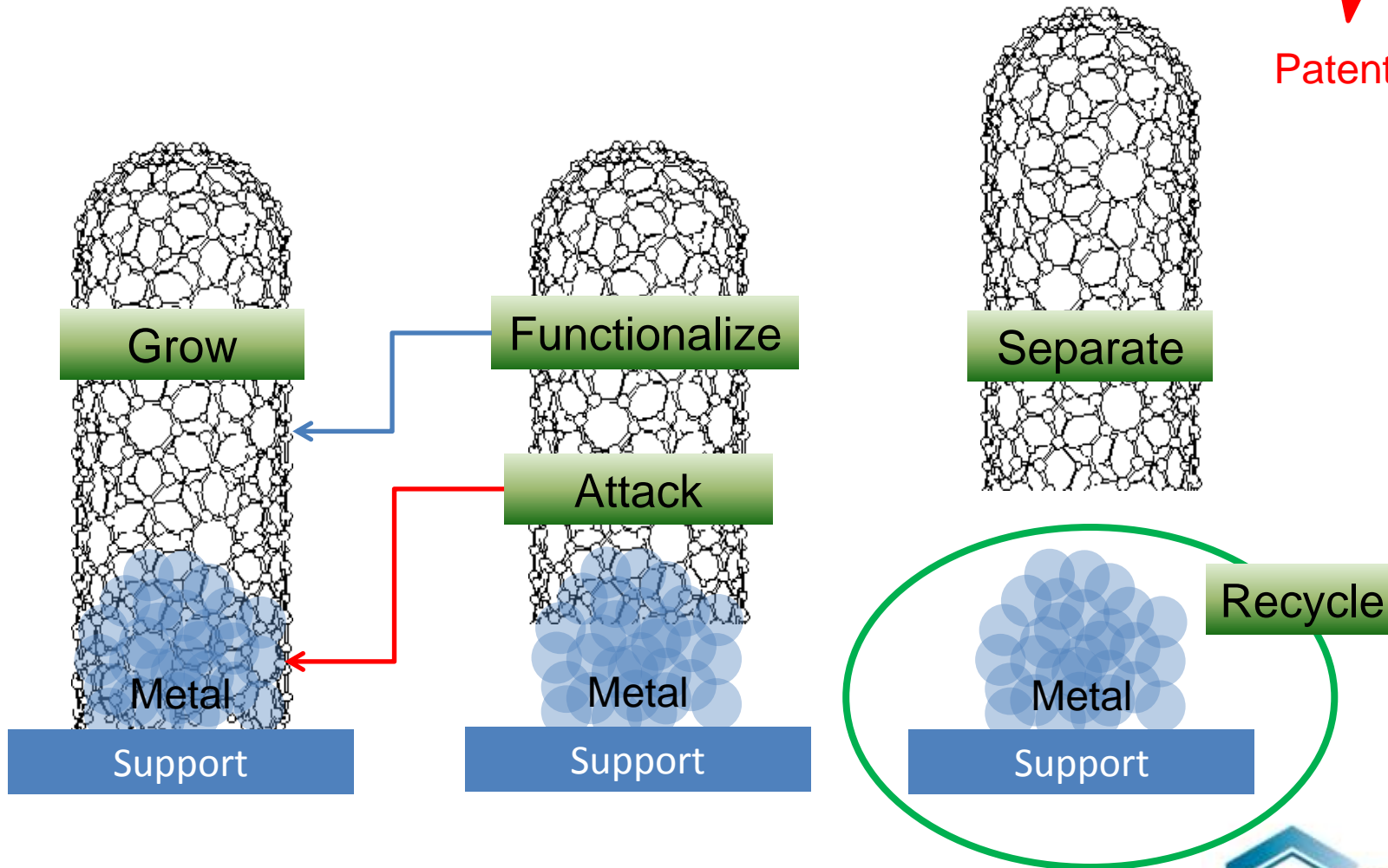
Low Cost



Innovative Solution (Part 2)

Harvest™

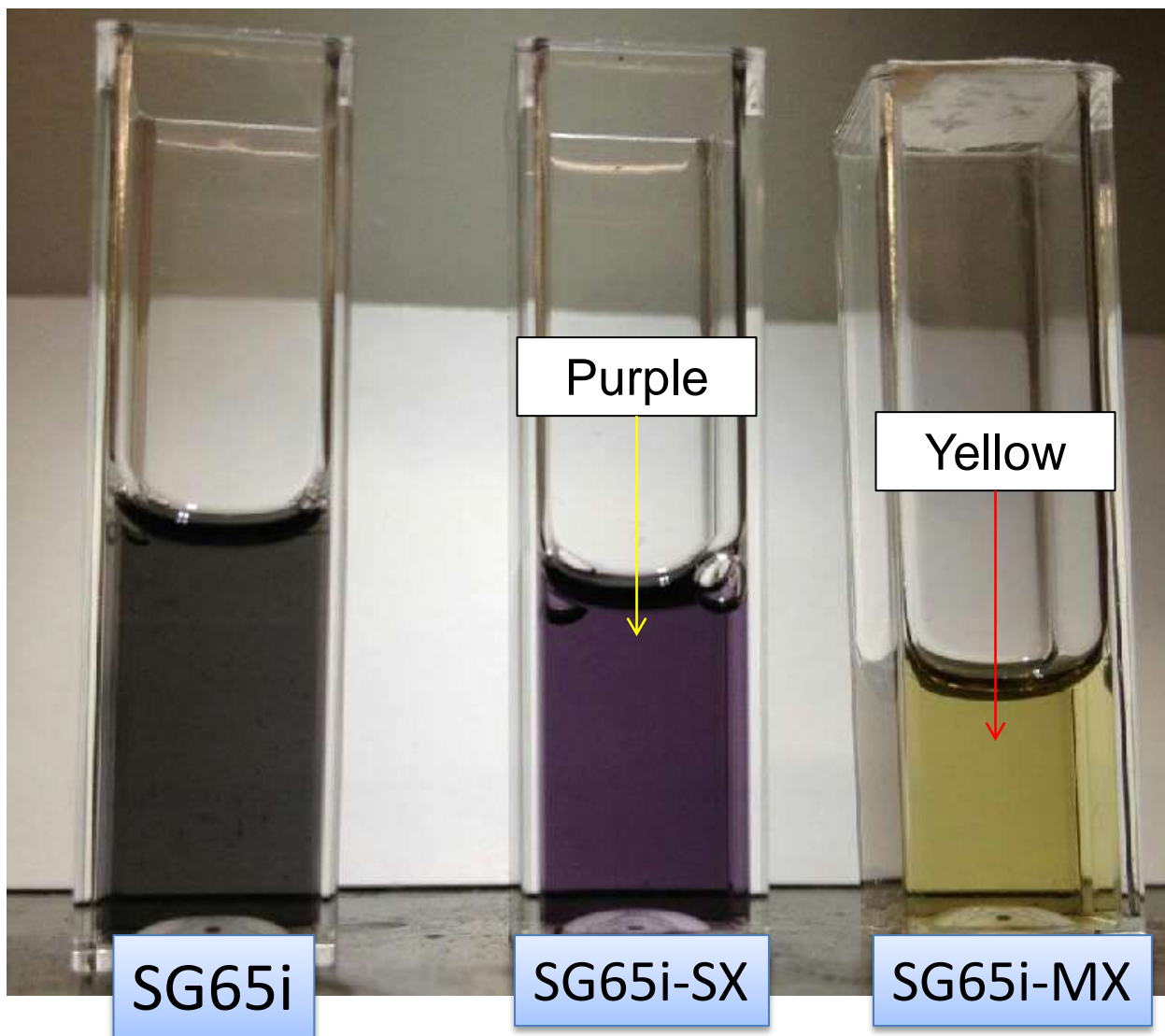
Patents Pending



Innovative Solution (Part 3)

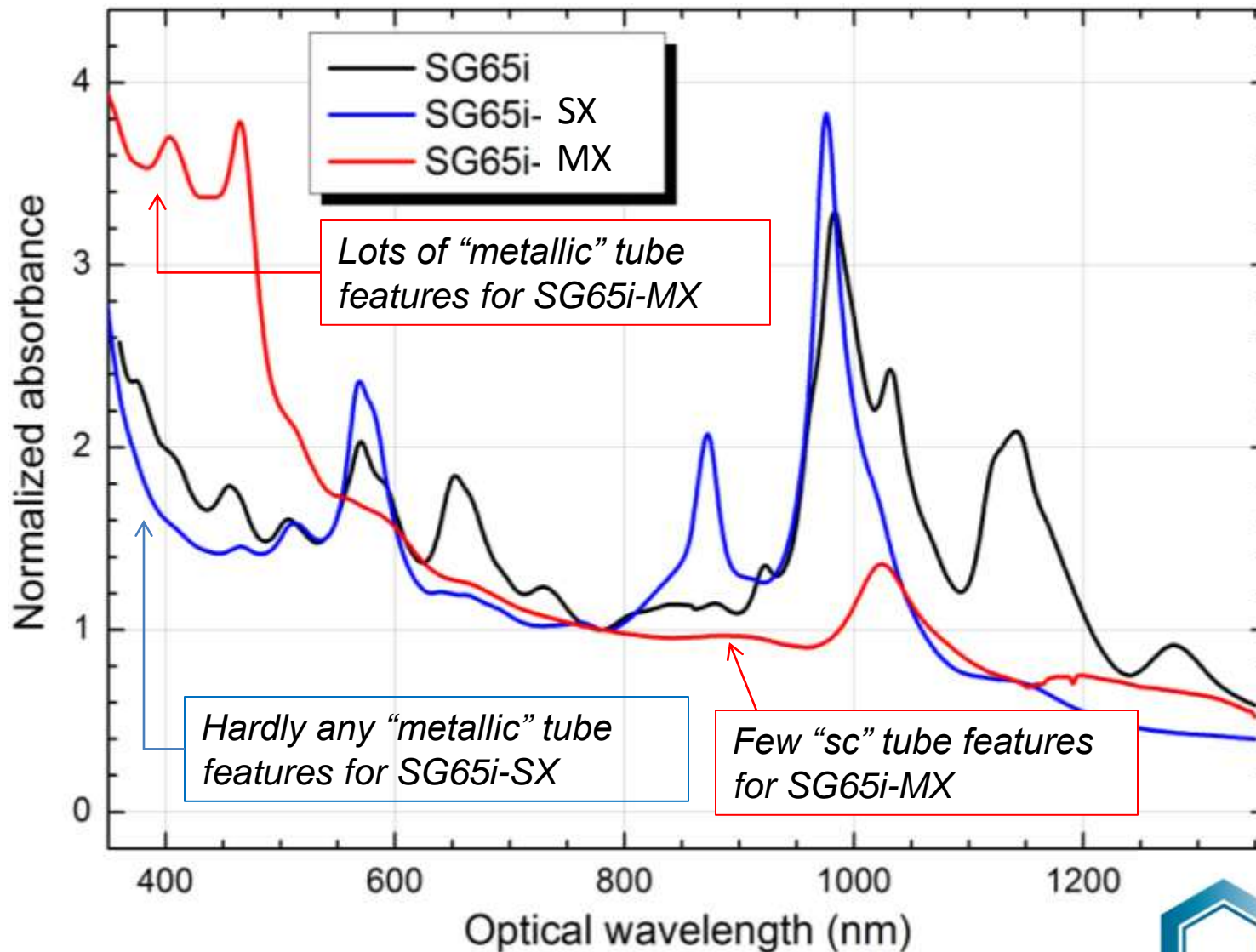
Chiral
Separation

*Does Not
Require Ultra
Centrifugation*



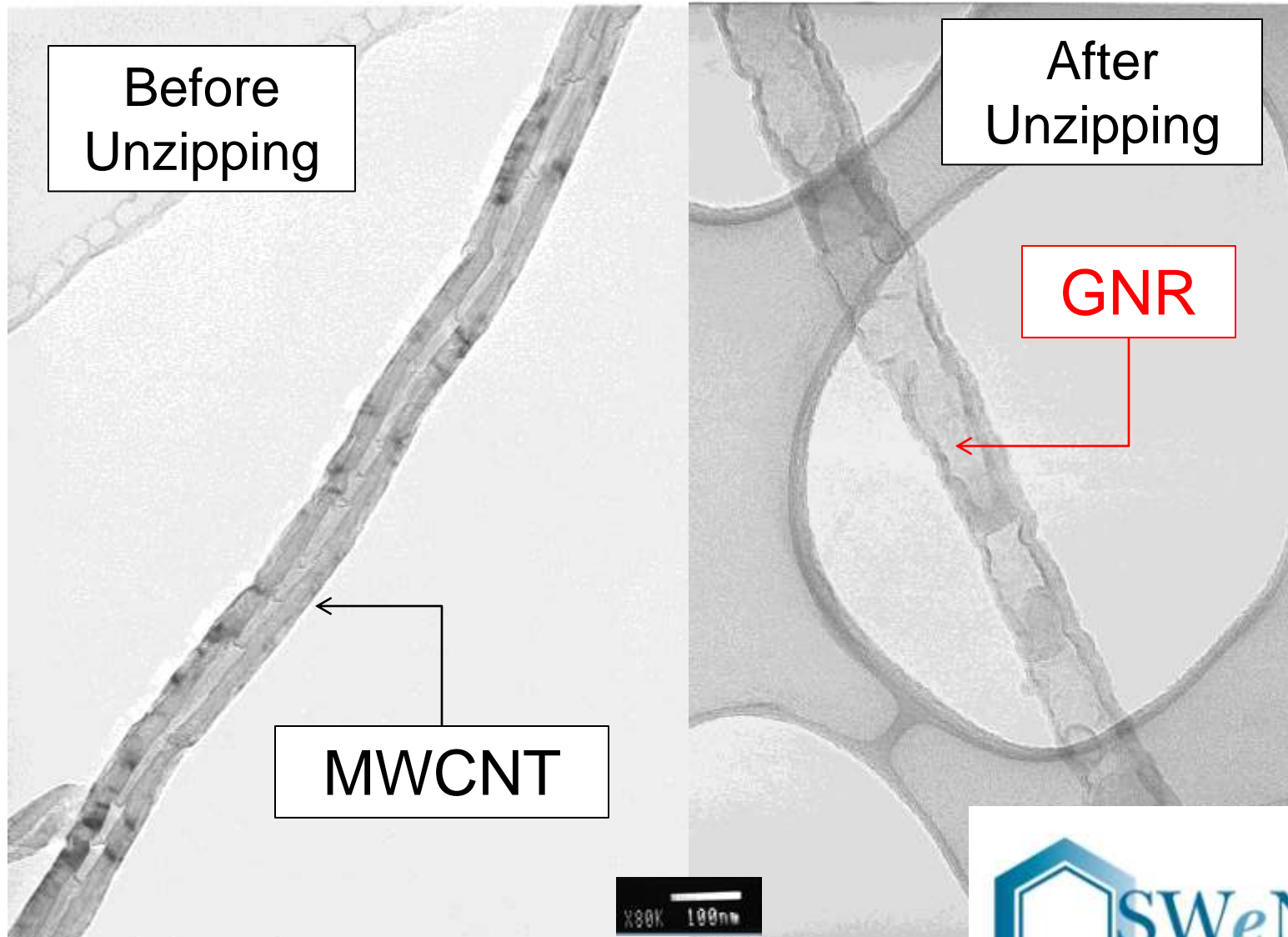
*“Color” for the
separated
fractions →
indication that
chiral
separation
has occurred.*

OA Spectral Comparison:

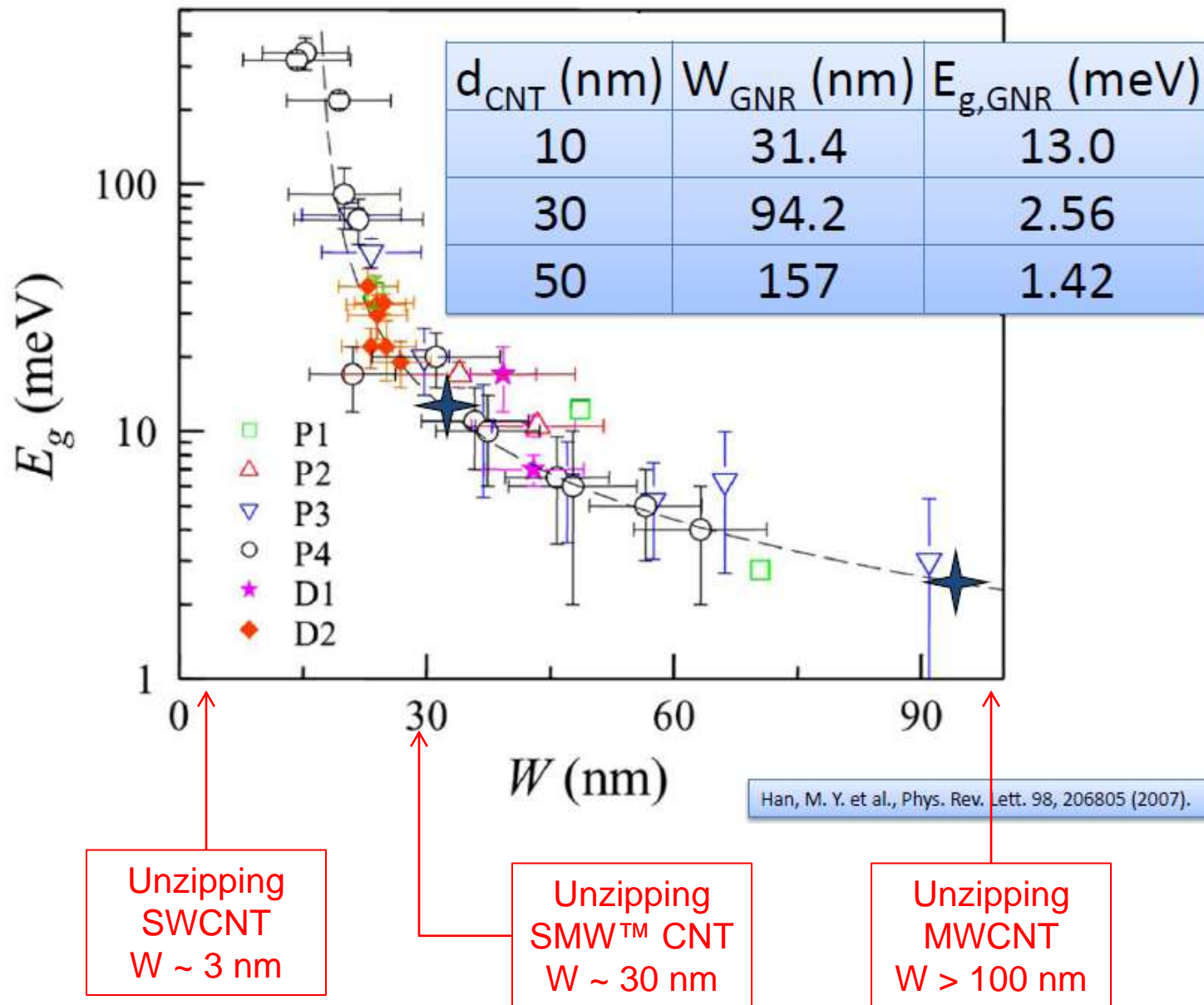


Unzipping Large Dia. MWCNT:

Research Project



Three types of CNTs are being studied for unzipping, which will lead to three different GNR band gap ranges:

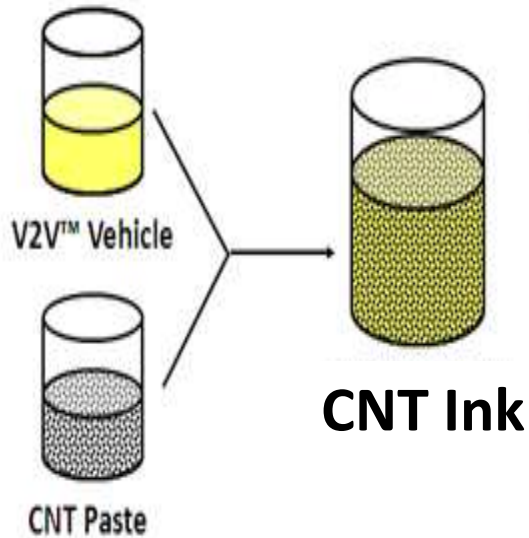


Innovative Solution (Part 4)

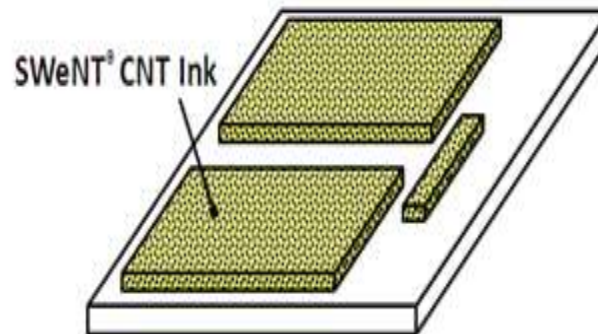
V2V™

Patents
Pending

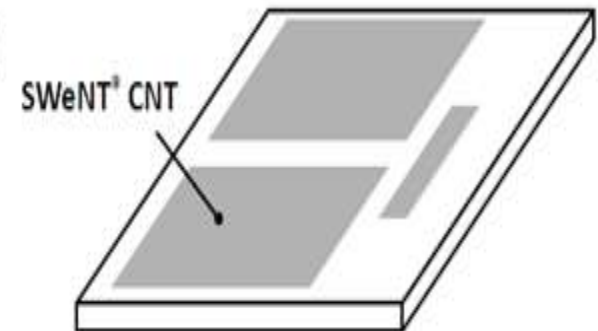
1) Mix



2) Print



3) Dry



***No residual surfactants
or processing aids!***

***CNTs can be printed using Standard
Industrial Printing Equipment***






































TCF Materials



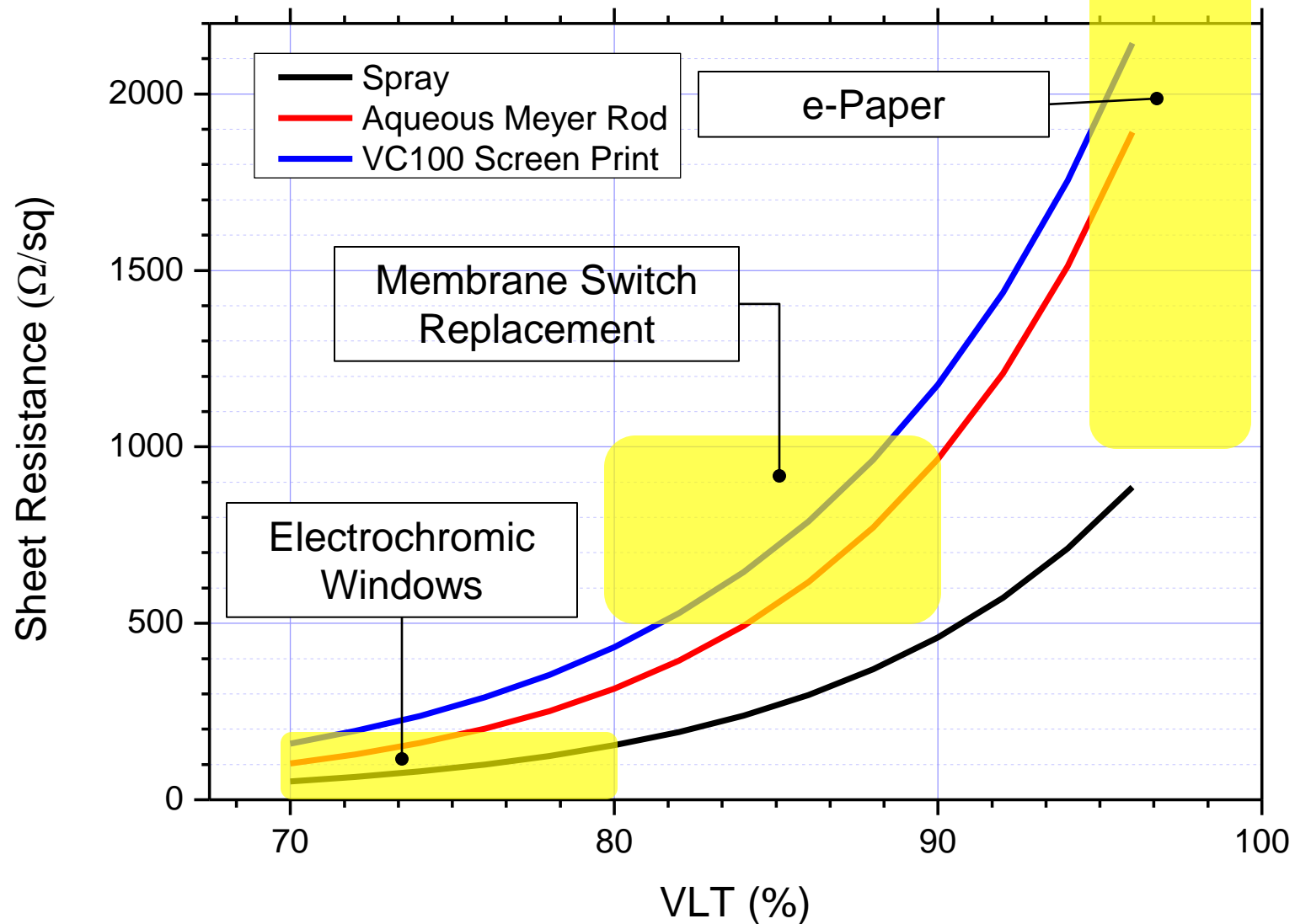
 Excellent

 Good

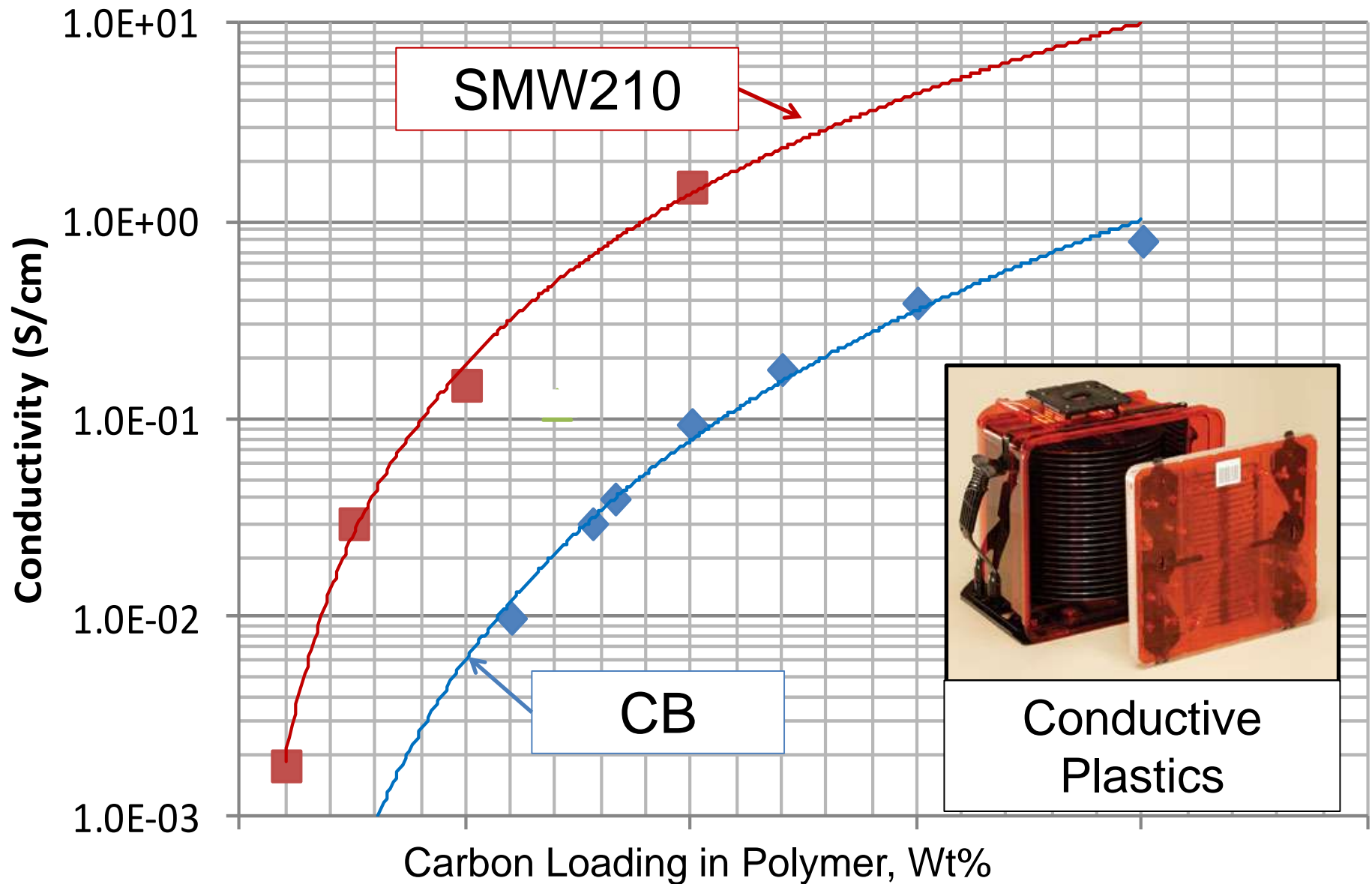
 Poor

TCF Materials	Conductivity	Flexibility	Printability	Stability	Color	Haze	Stretchability	Examples of Commercial Suppliers
ITO								Many Suppliers (Film)
Ag Grid								Pchem (Ink) Cabot (Ink)
Ag NW								Cambrios (Film) Carestream (Film)
PEDOT								Agfa (Ink, Film) Heraeus (Ink)
CNT								SWeNT (Ink) Unidym (Film)

Printable CNT TCFs

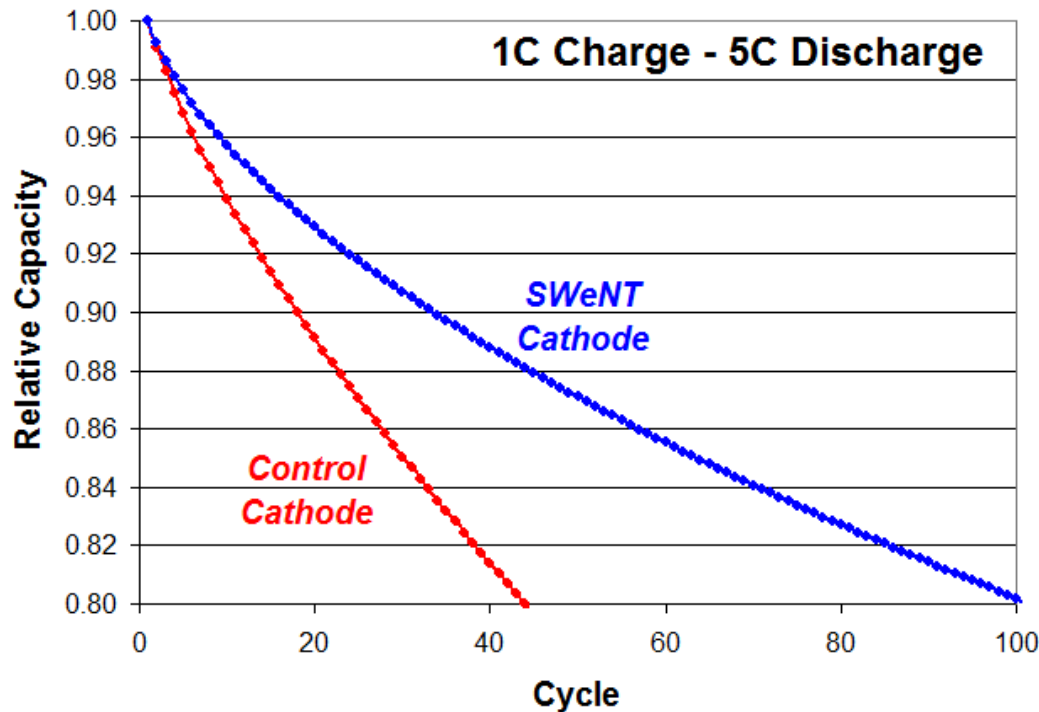


$> 1,000$ T/yr CNT



$> 1,000$ T/yr CNT

Cycle life improves 2x with only 1 wt% SMW200 in cathode!



> 10,000 T/yr CNT

Ultra Conductive (UC) copper overview

→ 1 wt% CNT increases electrical conductivity of Cu by > 30%!



We are hiring!



- Sr. Scientist (CNT Metrology)
- Sr. Scientist (CNT Functionalization)
- Sr. Scientist (Graphene)
- Director of Marketing
 - Electronic Materials
 - Composites



Made in USA