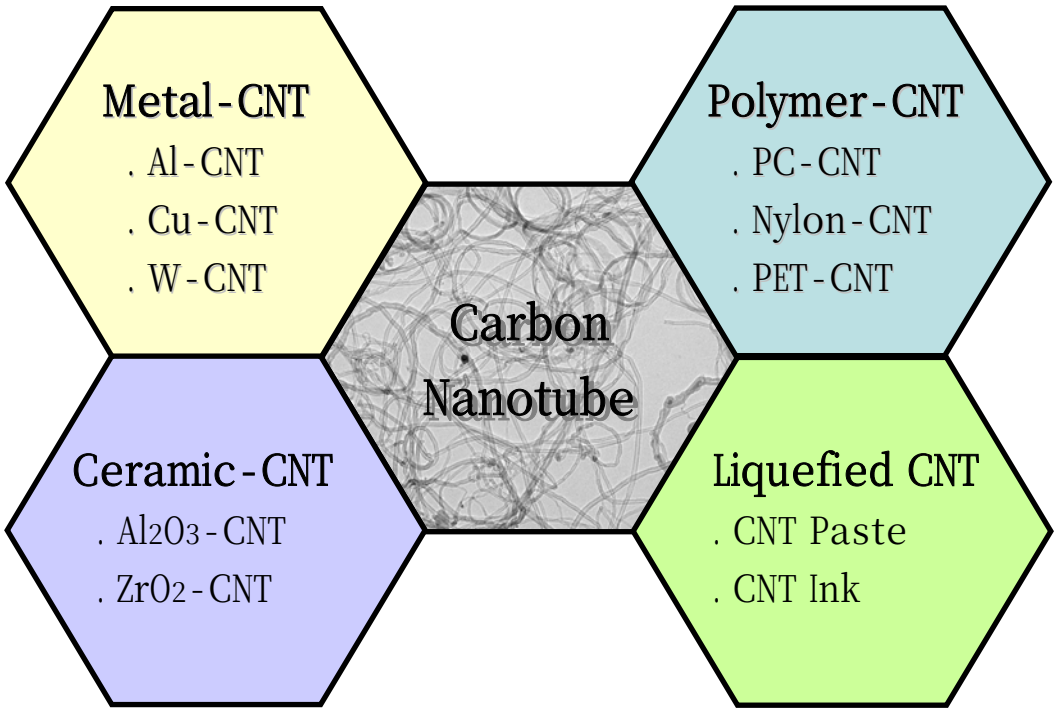
Dreamy Materials in Next Generation

Applied Carbon Nano Technology

To Create Carbon Nanotube World



Mass Production & Lowest Price !

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Metal-CNT Composite

- Lowest Cost & High Productivity
- Excellent Mechanical Properties
- Low Weight Structure Material
- Base Metal : Pure & Alloy metal

Generals

Features

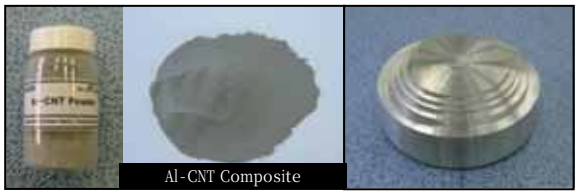
- Excellent Dispersibility of CNT in Metal Matrix
- Improved Strength by Metal-based Nano-crystalline
- Improved Strength & Toughness by Mechanical Properties of CNT
- Improved Conductivity by Electrochemical Properties of CNT
- Improved Abrasion Resistance by Nano-crystalline & CNT
- Light weight compared with the Existing High-strength Composites
- Low Cost Metal-CNT Composite compared with High Strength Composite
- Various Grade can be Manufactured depending on Application Fields

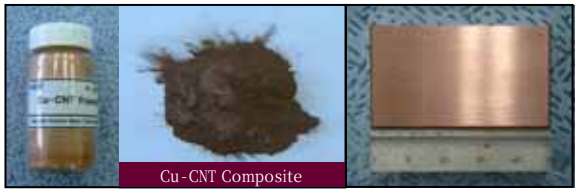
Type

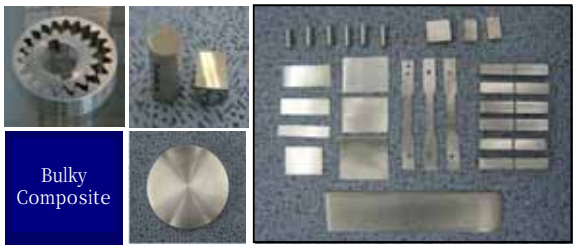
- Metal-CNT : Al-CNT, Cu-CNT, W-CNT, STS-CNT etc.
- Alloy-CNT : Al Alloy-CNT, STS-CNT, W alloy-CNT etc.
- CNT Contents : ~10 wt.%

Applications

- Light Weight Structures with High Strength & Toughness
  : Aerospace, Automobiles, Vessels and Leisure/Sports Apparatuses
- Abrasion-resistant Light Weight Materials
  : Aerospace, Automobiles, Tools and Machine
- Excellent Thermal and Electric Conductivity
  : Electronics, Computer, Automobiles, Aerospace and Precision Equipment



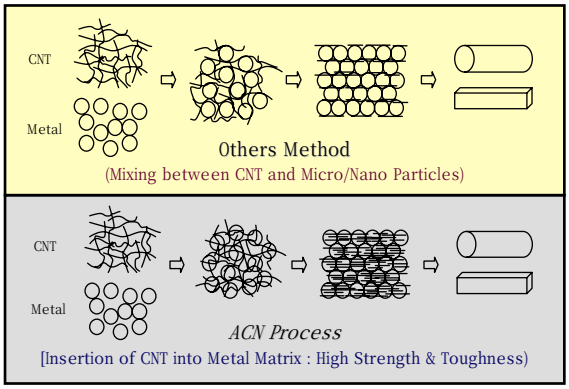




Characteristics

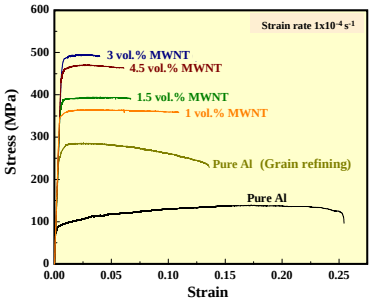
Comparison of Manufacturing Process

ACN Process : Lowest Price & Mass Production

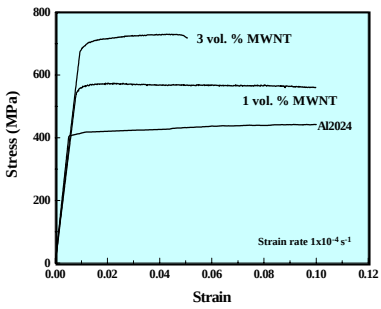


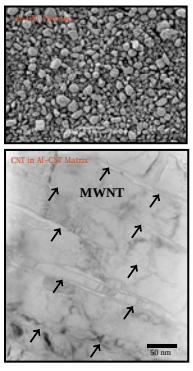
Excellent Mechanical Properties

Pure Al-CNT Composite

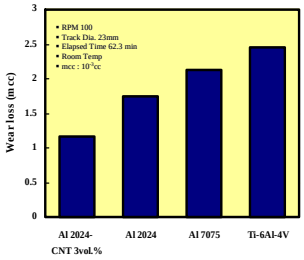


Al2024-CNT Composite

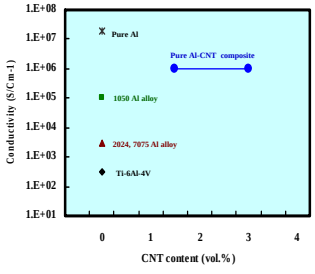




Abrasion Property



Electrical conductivity



Comparison of Mechanical Properties

	Yield Strength (MPa)	Tensile strength (MPa)	Elonga-tion (%)	Hardness (HRB)	Specific strength (MPa)	Electrical conduct. (IACS%)	Wear loss (10^{-3} cc)
2024 Al Alloy	324	469	19	70.5	174	12	1.74
7075 Al Alloy	435	505	13	80.5	181	9	2.13
Ti-6Al-4V	880	950	14	260~	198	-	2.45
Pure Al-CNT (CNT 3 vol.%)	440	475	5~10	83.2	176	55	-
Alloy Al-CNT (CNT 3 vol.%)	715	720	4	93.7	265	-	1.16

* Tension test : ASTM E8
* Wear test : RPM 100, Track Dia. 23mm, Elapsed time 62.3 min, Room temp.

Polymer-CNT Composite

- Uniform Dispersibility & Conductivity
- High Conductivity with Low Loading of CNT
- Excellent Physical Properties
- Maintain the Resin Physical Properties
- Extremely Low of Particle Sloughing

Generals

Features

- Improved Conductivity by Electrochemical Properties of CNT
- Improved Strength & Toughness by Mechanical Properties of CNT
- Uniform Dispersibility & Conductivity by using Metal-CNT Composite
  - Insertion of CNT into Metal particle : Control Length of CNT in Metal
  - Prevent Segregation of CNT in Extrusion
  - Role : CNT (Conductivity), Metal (Dispersibility & Conductivity)
- Realization of High Conductivity with the Minimum Addition of CNT
- Maintaining the Properties of the Base Material's own
- Decreased Particle Sloughing
- Extended Lifetime

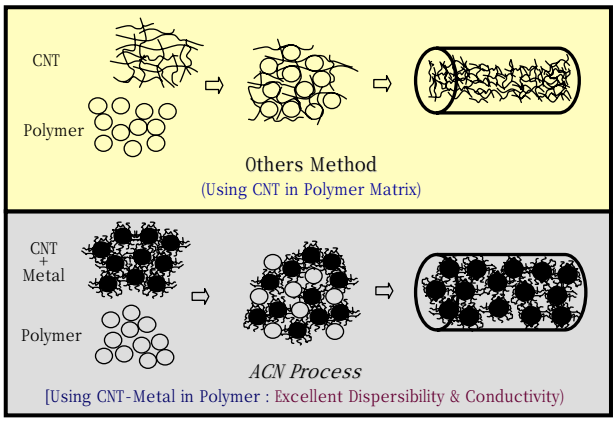
Type

- PC-CNT, Nylon-CNT, PET-CNT, PE-CNT etc.
- CNT Contents : ~20 wt.%

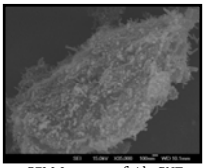
Applications

- Shielding Material (ESD & EMI)
  : Mobile, Cloth, Computer, Glove, Shoes, Matt, Tile, Tray, Tape, Box, Bag, Film etc.
- Engineering Plastic, Heat sink
  : Aircraft, Automobile, Aerospace, Electronic, Medical, Vessel Sports equipment, etc.

Comparison of Manufacturing Process



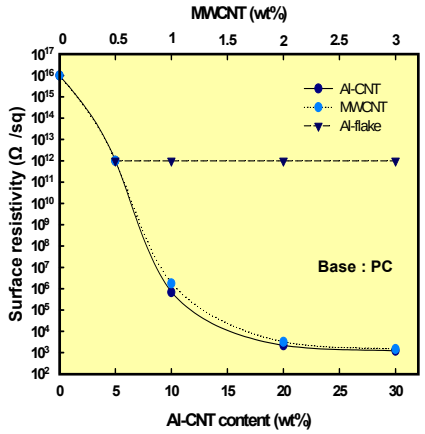

Al-CNT Composite


SEM Image of Al-CNT

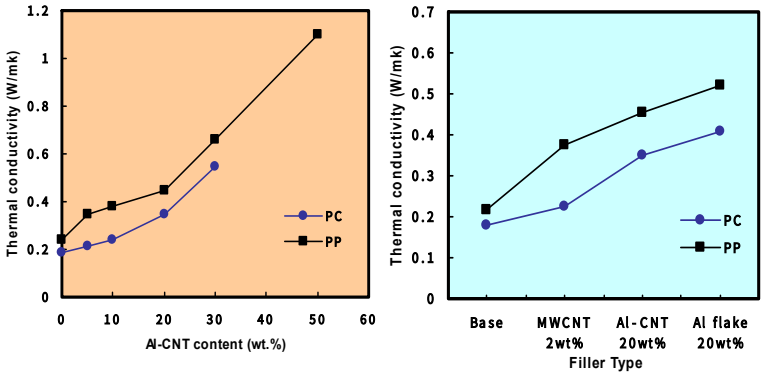

Polymer-Al-CNT M/B

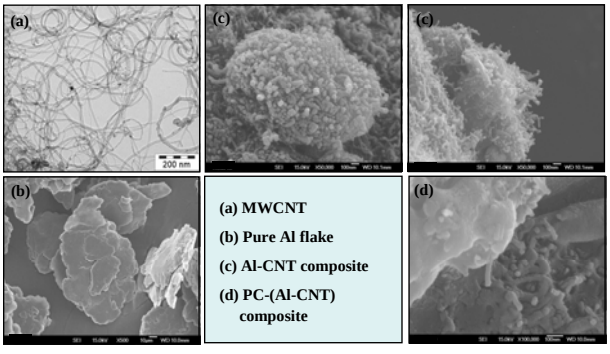
Characteristics

Surface Resistivity of Polymer-CNT

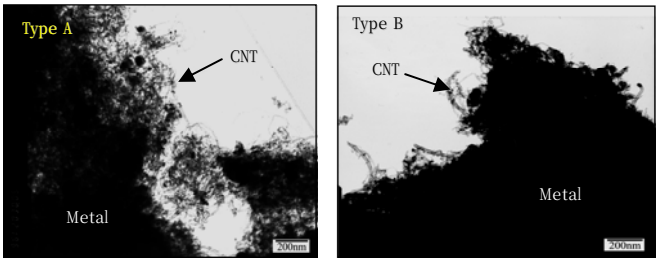


Thermal Conductivity of Polymer-CNT





Outer Length of CNT in Metal-CNT for Polymer-CNT Composite
(Conductivity : A > B)



Liquefied CNT

- Uniform Dispersibility & Conductivity
- Highly Electric/Thermal Conductivity
- Excellent Dispersibility of CNT
- Highly Photocatalyst Property

Generals

Features

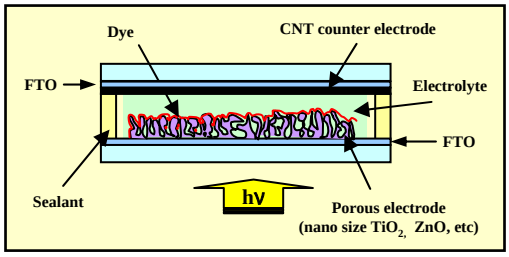
- CNT-used Liquid high conductive paste & ink
- Low cost CNT for expensive Pt & Ag
- Excellent electric conductivity & thermal emission property
- Environmental-friendly materials with conductivity & photocatalyst
- Various grade can be manufacturing depending on application fields
- Convenient usage : Spray, coating etc.

Type

- CNT Paste : 10^1~10^2 Ω/sq.
- CNT Ink : 10^2~10^5 Ω/sq.

Applications

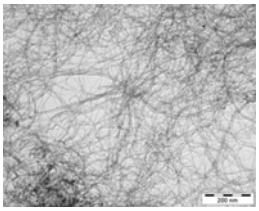
- ESD, EMI
- Dye-sensitized solar cell counter electrode
- Adsorption of harmful gas, Pollution decomposition



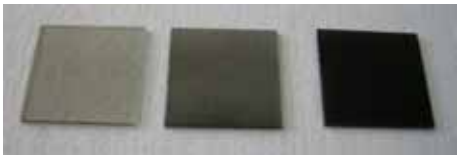
DSSC modules with CNT counter electrode

CNT ink

CNT Paste



High Dispersibility CNT for Liquefied CNT



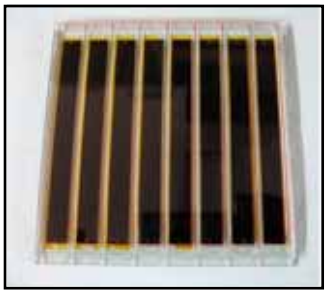
CNT Counter Electrode of DSSC

DSSC modules with CNT counter electrode (KERI-ACN)

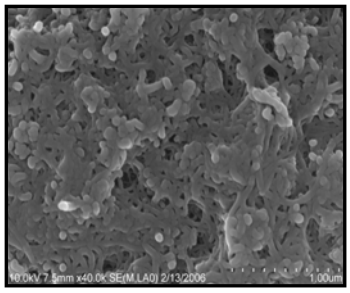
Dye-sensitized Solar Cell CNT Counter Electrode

Feature

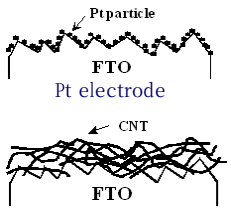
- Low cost CNT counter electrode for expensive Pt counter electrodes
- High photo-electric conversion in low level illumination
- High efficiency and stability in comparison with Pt DSSC



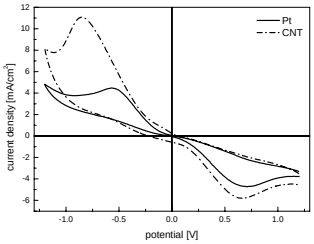
DSSC modules with CNT counter electrode



SEM image of CNT electrode



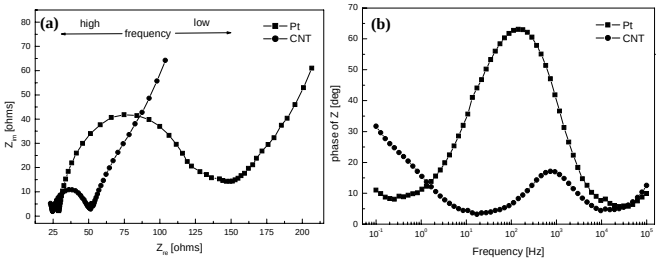
CNT electrode



Cyclic voltammogram of Pt and CNT (Scan rate : 100 mV/s)

PROPERTY

- Sheet resistance
  : CNT electrode Pt electrode (Excellent Conductivity)
- Electrochemical properties
  : CNT electrode 〉 Pt electrode (CV & impedance spectrum)
- CNT Electrode
  : Excellent performance & Simple Process
  → CNT : Low resistance, Excellent electron emission
  Large surface area, Low cost



Impedance spectrum (a) Nyquist plots (b) Bode plots

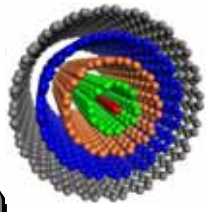
Carbon Nano Tubes

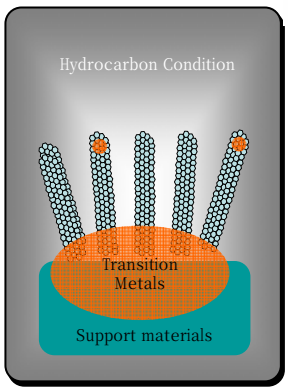
- Mass production and Lowest price
- Excellent mechanical/Electrical/Thermal property
- High chemical stability
- Various technological applications

Generals

Features

- New dreamy material in the 21st century
- Tubular material with hexagonal honeycomb structure
- Remarkable electronic/thermal and mechanical properties
- Mass production and lowest price
- Wide use and various technological applications
- Environmental-friendly materials with conductivity & strength



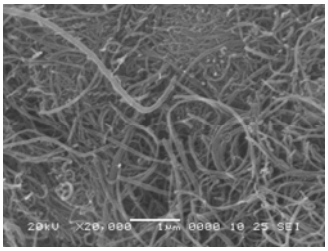


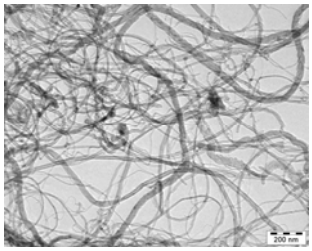
Typical Properties of MWCNT

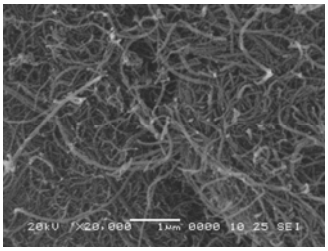
Properties		Value	Remarks
Electrical Resistivity (Ω·cm)		0.1	Pure Cu (1.67)
Thermal Conductivity (W/m/K)		~2,000	Pure Al (236)
Elastic Behavior	Young's Modulus (MWNT)	1.28 TPa	
	Maximum Tensile strength	~100 GPa	SUS 304 (0.6 Gpa)

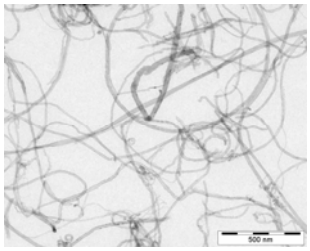
Properties and Qualities

Type	Purity	Dia (nm)	Length (um)	Remarks
CNT90	over 90 wt.%	5~20	~10	Catalyst CVD
CNT97	over 97 wt.%	5~20	~10	Purified CNT90









Applications

- Electron emitter, light source
- Electro-magnetic interference (EMI), Electro-static discharge (ESD)
- Solar cell electrode, Fuel cell electrode
- Rechargeable battery
- Metal/Ceramic/Polymer composite
- CNT paste & ink
- Removal sick house syndrome, adsorption of harmful gas, pollution decomposition