

Metal+CNT Composite(A-Metal)

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

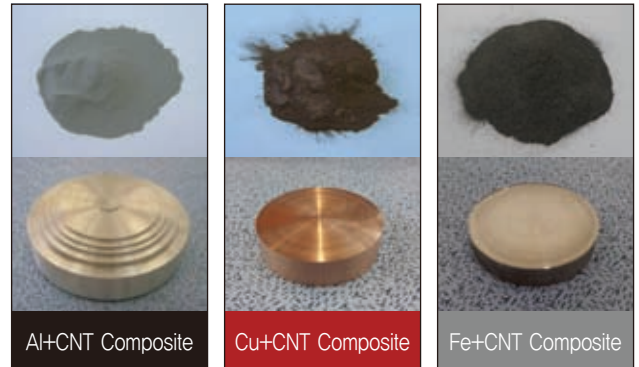
Generals

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, Fe+CNT, Zn+CNT etc.
- Alloy+CNT : Al Alloy+CNT, STS+CNT, SKD+CNT etc.
- CNT Contents : ~10 wt.%



A-Metal	Products	Features
Al+CNT	A-Al6 (600 MPa)	<ul style="list-style-type: none"> • Shape <ul style="list-style-type: none"> - Powder : 5~40 um - Bulk : D50~100mm H50mm • Applications Strength, Toughness, Wear resistance, Conductivity etc.
	A-Al5 (500 MPa)	
	A-Al4 (400 MPa)	
Cu+CNT	A-Cu (CNT 1~10 wt.%)	
Fe+CNT	A-Fe (CNT 1~10 wt.%)	
STS+CNT	A-STs (CNT 1~10 wt.%)	
Others	Zn, SKD, Ni, Alloy etc.	

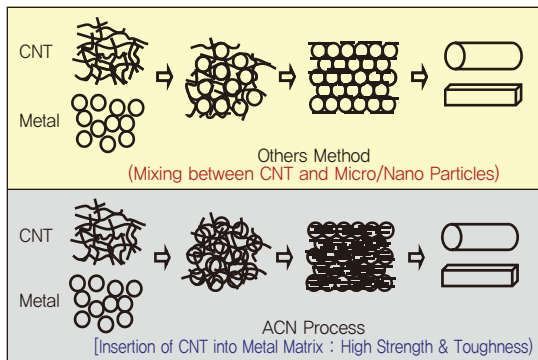
Applications

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

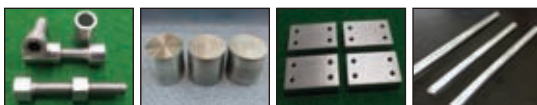
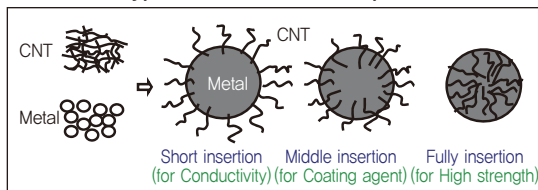
Characteristics

Comparison of Manufacturing Process

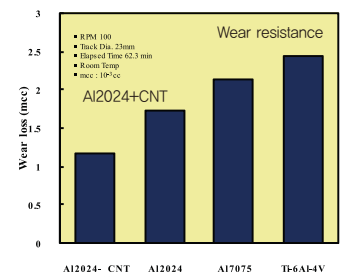
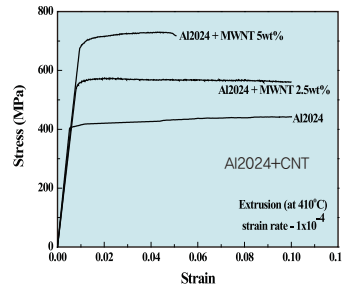
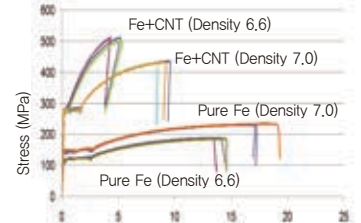
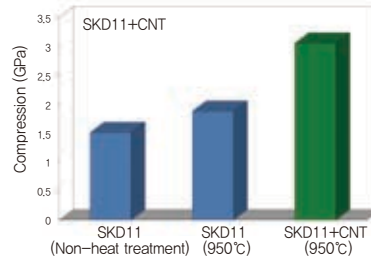
ACN Process : Lowest Price & Mass Production



Various Type of Metal+CNT Composite Powder



Excellent Mechanical Properties



	Yield Strength (MPa)	Tensile strength (MPa)	Elongation (%)	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	440	475	5~10	83.2	176	55	-
2024 Al+CNT	715	720	4	93.7	265	-	1.16

Polymer+CNT Composite(A-Pol)

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

Generals

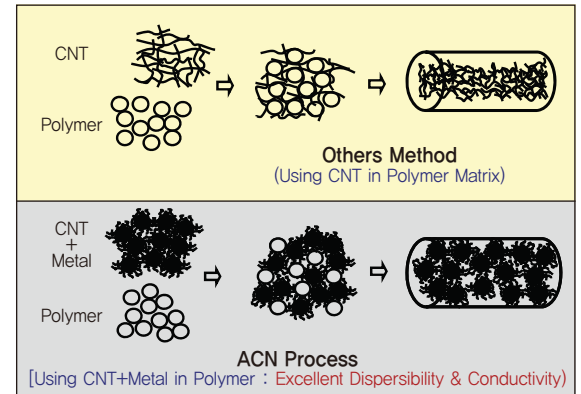
Features

- 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

	Type	Products	Features
Solid	PC+CNT	A-PC-20	<ul style="list-style-type: none"> • Shape : M/B • CNT : ~20 wt.%
	PP+CNT	A-PP-20	
	PA66+CNT	A-PA66-20	
	Others	Order base	
Paste	Epoxy+CNT	A-Epoxy-3	<ul style="list-style-type: none"> • Shape : Paste • CNT : ~3 wt.%
	Urethane+CNT	A-Urethane-3	
	Others	Order base	

Comparison of Manufacturing Process

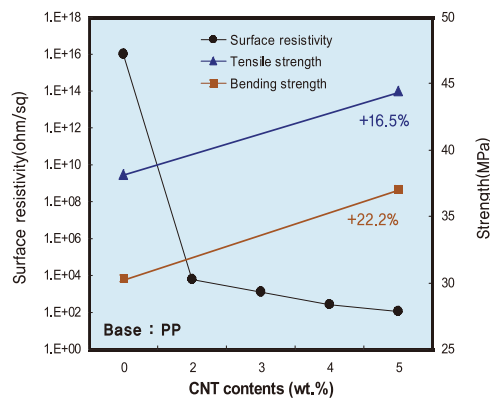
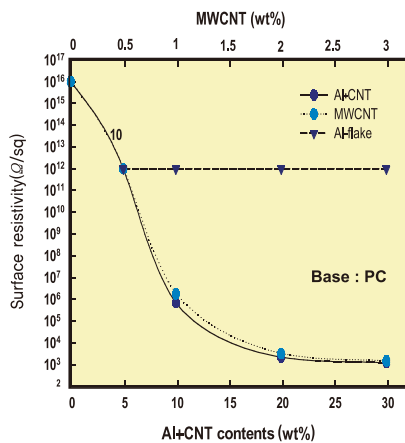


Applications

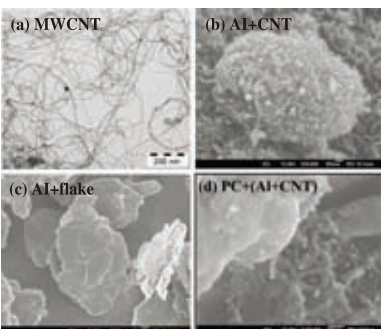
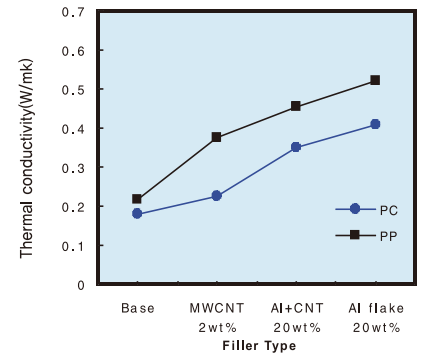
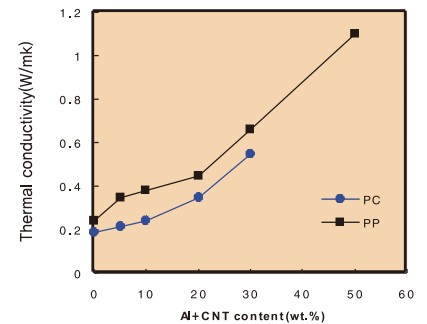
- **Shielding Material (ESD & EMI)** :
Mobile, Cloth, Computer, Glove, Shoes, Matt, Tile, Tray, Tape, Box, Bag, Film etc.
- **Engineering Plastic, Heat sink** :
Aircraft, Automobile, Aerospace, Electronic, Medical, Vessel Sports equipment, etc.

Characteristics

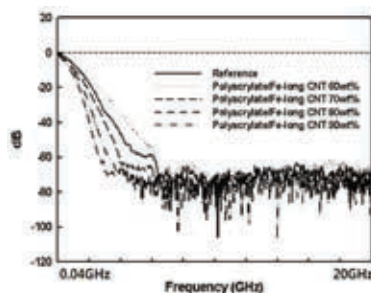
Surface Resistivity & Strength



Thermal Conductivity



Electro Magnetic Absorption



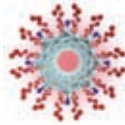
Ceramic+CNT Composite(A-Ceram)

- ▶ Uniform Dispersibility & Conductivity
- ▶ High Conductivity with Low Loading of CNT
- ▶ Excellent Physical Properties
- ▶ Maintain the Ceramic Physical Properties

Generals

Features

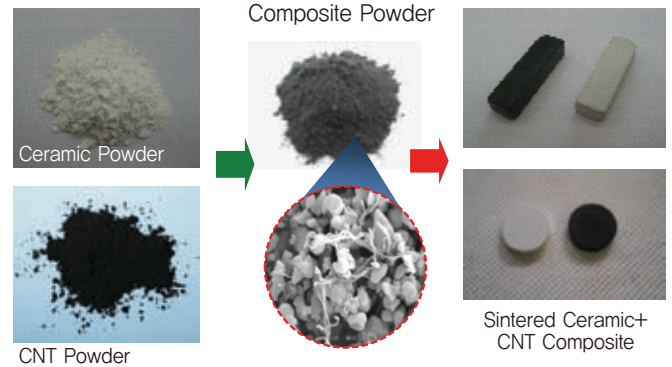
- Improved **Conductivity** by Electrochemical Properties of CNTs
- Improved **Strength & Toughness** by Mechanical Properties of CNTs
- Improved **Abrasion resistance** by Appearance Properties of CNTs
- Realization of **High Conductivity** with the **Minimum Addition of CNT**
- Maintaining the Properties of the Base Ceramic's Own
- Decreased **Particle Sloughing**
- Extended Lifetime



Type

Type	Products	Features
Al ₂ O ₃ +CNT	A-OAl (CNT 1~10 wt.%)	<ul style="list-style-type: none"> • Shape : Powder • Usage : Sintering, Coating
ZrO ₂ +CNT	A-OZr (CNT 1~10 wt.%)	
TiO ₂ +CNT	A-OTi (CNT 1~10 wt.%)	
SiO ₂ +CNT	A-OSi (CNT 1~10 wt.%)	
Others	Order base	

Manufacturing Process of Ceramic+CNT Composite

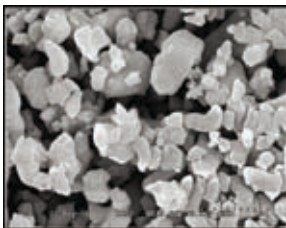


Applications

- Ceramic coating materials with **high strength** and **high toughness**
- Industrial materials requiring **electric and thermal conductivity**
- Ceramics for shock absorption
- **Wear resistant ceramics**

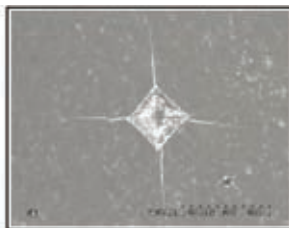
Characteristics

SEM Image

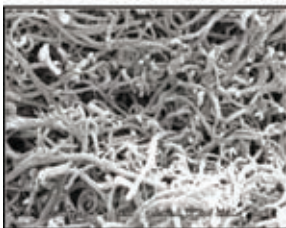


Raw ceramic powder

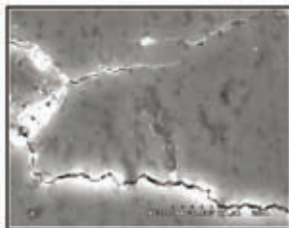
Crack Propagation Behavior



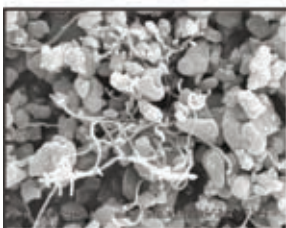
Vickers hardness press mark



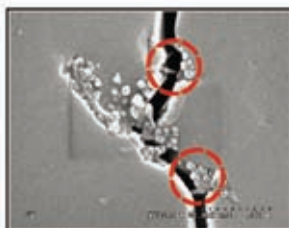
Carbon Nanotube (MWCNT)



Prevent crack propagation

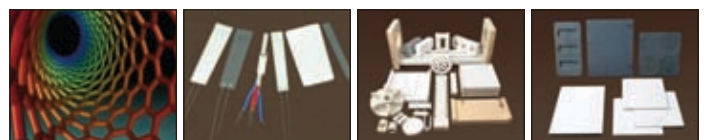
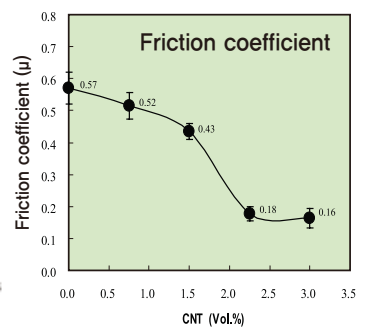
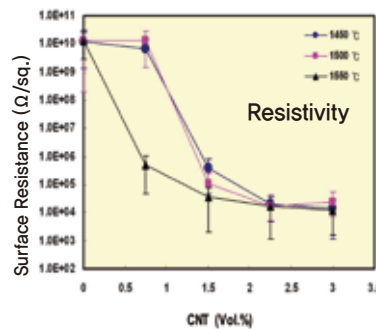
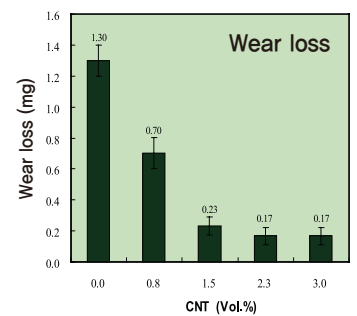
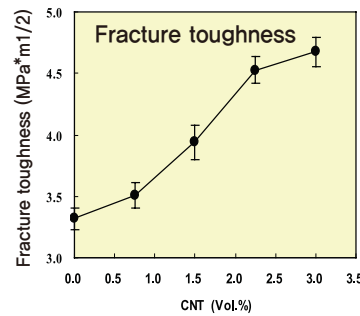


Ceramic+CNT Composite



Crack bridging by CNT

Excellent Mechanical Properties



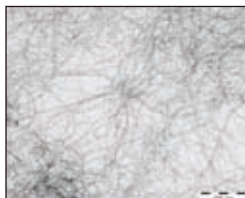
Liquefied CNT(A-Sol)

- ▶ 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 for expensive conductive materials
- Excellent electric and thermal conductivity
- Environmental-friendly materials
- Various grade and solutions
- Usage : Spraying, Printing, Dr.Blade etc.



High dispersibility CNT



CNT Paste



CNT Ink

Type

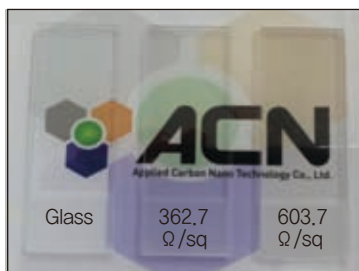
Items	Type	Products	Features
Ink	MWCNT	A-Sol-D3 (DIW) A-Sol-A2 (Alcohol)	<ul style="list-style-type: none"> • Viscosity : ~500 cP • Resistivity : $10_1 \sim 10_4 \Omega/\text{sq}$. • Transparency : ~ 85% • Usage : Spray/Roll/Spin coating,
	SWCNT	A-Sol-D01 (DIW) A-Sol-A01 (Alcohol)	
	Graphene	A-Sol-D3-G (DIW) A-Sol-A2-G (Alcohol)	
Paste	MWCNT	A-Sol-D10 (DIW) A-Sol-A10 (Alcohol)	<ul style="list-style-type: none"> • Viscosity : ~35,000 cP • Resistivity : $10_1 \sim 10_4 \Omega/\text{sq}$. • Usage : Screen printing, Dr. Blade
	Graphene	A-Sol-D10-G (DIW) A-Sol-A10-G (Alcohol)	

Applications

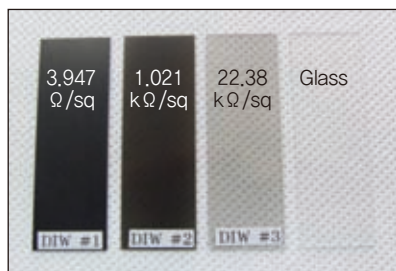
- Excellent electric conductivity : ESD, EMI, Heating element
- High thermal conductivity : Heat dissipation, Heat insulation
- Dye-sensitized solar cell counter electrode
- Superior mechanical property of coating layer
- Adsorption of harmful gas, Pollution decomposition

Property

Transparency Electrode (SWCNT Ink)



Conductive Coating(MWCNT Ink)



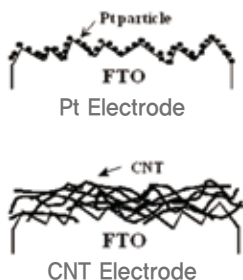
MWCNT Paste



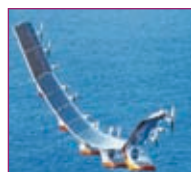
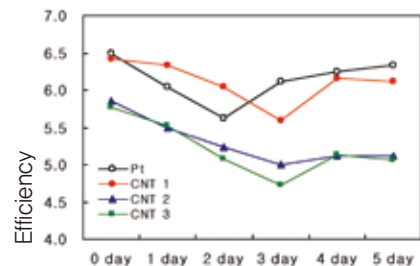
DSSC Module(CNT counter electrode)



CNT coating Layer



Comparison of efficiency(Pt:CNT)



Carbon Nanotube(A-Tube)

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

Generals

Features

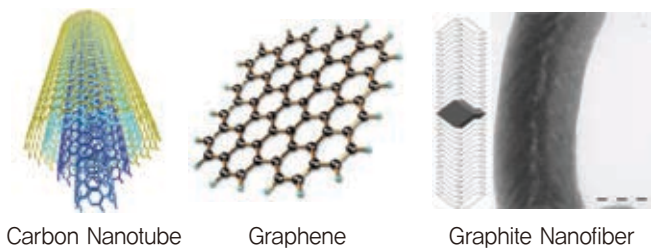
- New dreamy material in the 21st century
- Tubular material with hexagonal honeycomb structure
- Excellent electronic/thermal/mechanical properties
- Mass production and lowest price
- Wide use and various technological applications
- Environmental-friendly materials

Typical Properties of MWCNT

Properties		Value
Electrical Resistivity($\Omega \cdot \text{cm}$)		0.1
Thermal Conductivity(W/m/K)		~2,000
Elastic Behavior	Young's Modulus(MWNT)	1.28 TPa
	Tensile strength	~100 GPa

Applications

- Electromagnetic interference, Electrostatic discharge
- 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

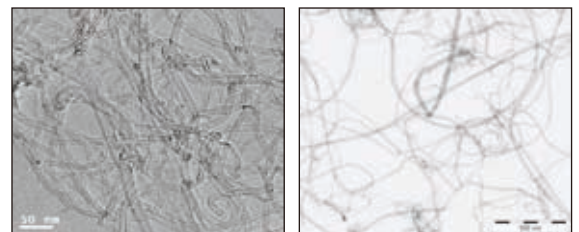


Properties and Qualities

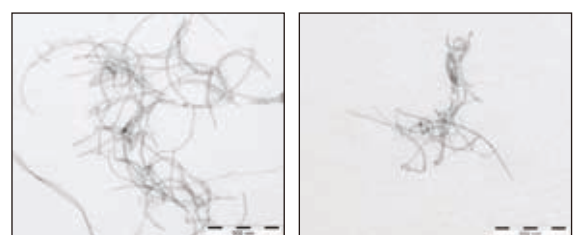
Products

Type	Products	Features
MWCNT	A-Tube-M85 A-Tube-M90 A-Tube-M95 A-Tube-M97-P	- CCVD - Dia. : 5~20 nm - Length : ~10 μm - Purity : 85~97 wt.%
MWCNT (Chopped)	A-Tube-90-C1 A-Tube-90-C3	- Dia. : 5~20 nm - Length : ~1, 1~3 μm - Purity : 90 wt.%
TWCNT (Thin wall)	A-Tube-T95	- Dia. : 5~10 nm - Length : ~10 μm - Purity : 95 wt.%
Others	Graphene, CNF etc.	

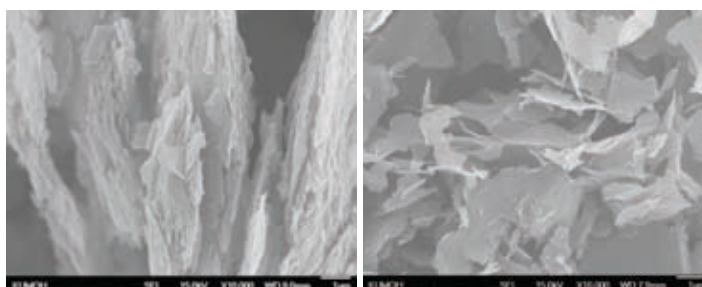
Shape



Normal MWCNT



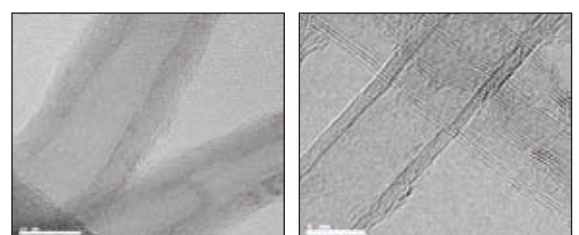
Chopped CNT



Before

After

Dispersion of Graphene



MWCNT

TWCNT

Engine Oil Additive "EnginAid"

- ▶ Chopped CNT, Nano Pt dispersed in oil
- ▶ Up to engine Power
- ▶ Saving the Fuel
- ▶ Superior thermal behaviors of Oil
- ▶ Can be used in all kinds of cars

Generals

Features

- Nano Pt & Chopped CNT are uniformly dispersed in engine oil
- Nano materials are coated in scratched part of engine inner surface
- Nano Pt : Promote perfected combustion, decrease toxic waste gas
- Chopped CNT in Nano size : Improve Lubrication & thermal conductivity
- High performance engine oil additive :
Decrease fuel consumption, Improve engine performance,
Prevent wearing of friction surface of engine, Less noisy
- Application : Motor, Aircraft, Vessel, Motorcycle, Industrial Engine
- Patents : 3 (Miso-N, Chopped CNT, Nano Pt)

How to Use

- In common use for Gasoline, Diesel, LPG.
- After shaking several times, pour Miso-N into engine oil in any time, but after engine oil exchange is better.
- With one bottle, no need to change engine oil up to 15,000~20,000 km, but we recommend up to 10,000 km in order to get better effects.



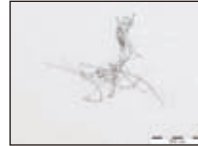
Characteristics



Main Components

Classification	EnginAid	Other products
Main Materials	Carbon nanotube(CNT), Nano Platinum (Nano Pt)	PTFE, Metal Powder, Mo compound, Graphite, Ceramic powder etc.
Function	Recover engine as a optimal situation & help perfect combustion	Improve the quality of engine oil
Durability	No risk of oxidation and burning in any condition of temperature	In harsh condition, there is a risk of oxidation in main materials (severe negative effects in engine)
Applying	There is no limit, can be used in all kinds of cars and any time, it can be applied regardless the time of oil change	There are different applying method according to the kinds of cars, fuels, and it can not be applied in any time
Continuance	One time using, the effect is lasted till 10,000~20,000 km	In the beginning there is certain effects but in some time, the effects are disappeared

Main Components



Chopped CNT

- Excellent electric & thermal conductivity
- Self lubricant
- Excellent chemical stability
- CNT length control (Patent)



Nano Platinum(Pt)

- Excellent Catalyst
- Evenness of the size
- Excellent dispersibility (Patent)

Sort

- 100 ml : Passenger Car, SUV
- 500 ml : Bus, Truck
- 4 L : Mass consumption company

Main Components

Classification		Before (km/ℓ)	After (km/ℓ)	Fuel Saving Rate(%)
Gasoline	Hyundai, 1500cc DOHC ('97)	11.03	12.90	+17.0
	Samsung, 2000cc ('01)	13.33	14.59	+9.5
	Hyundai, 2000cc DOHC ('99)	11.6	12.8	+10.3
	KIA, 800cc (2000)	13.23	14.99	+13.3
	Daewoo, 1800cc ('96)	6.87	7.74	+12.7
	Hyundai, 2500cc ('97)	7.96	9.12	+14.6
Diesel	Hyundai, 2000cc ('99)	8.71	9.33	+7.2
	KIA, SUV 2500cc ('04)	10.8	13.6	+25.9
	KIA, SUV 2500cc ('05)	11.4	13.5	+18.6
LPG	Hyundai, 14Ton Truck ('99)	3.62	3.79	+4.7
	Hyundai, 2000cc ('04)	9.94	10.84	+8.98
	Hyundai, 2000cc ('05)	9.89	10.88	+9.95

Main Components

Classification	Saving the fuel(%)	RPM at 80km/h	Power	Noisy	Interval time to normal engine Temperature
K-131 (Jeep, Gasoline)	+25.9	2,800 (300 ↓)	Up	Reduce	Faster
K-311 (5/4T, Diesel)	+19.2	-	Up	Reduce	Faster
K-511 (2.5T, Diesel)	+26.3	2,300 (200 ↓)	Up	Reduce	Faster

Main Components

Classification	HC(ppm)	CO(%)	NOx(ppm)	CO2(%)
Before	50	0	212	15
After	14	0	218	15
Limited Value	190	1.2	1440	-