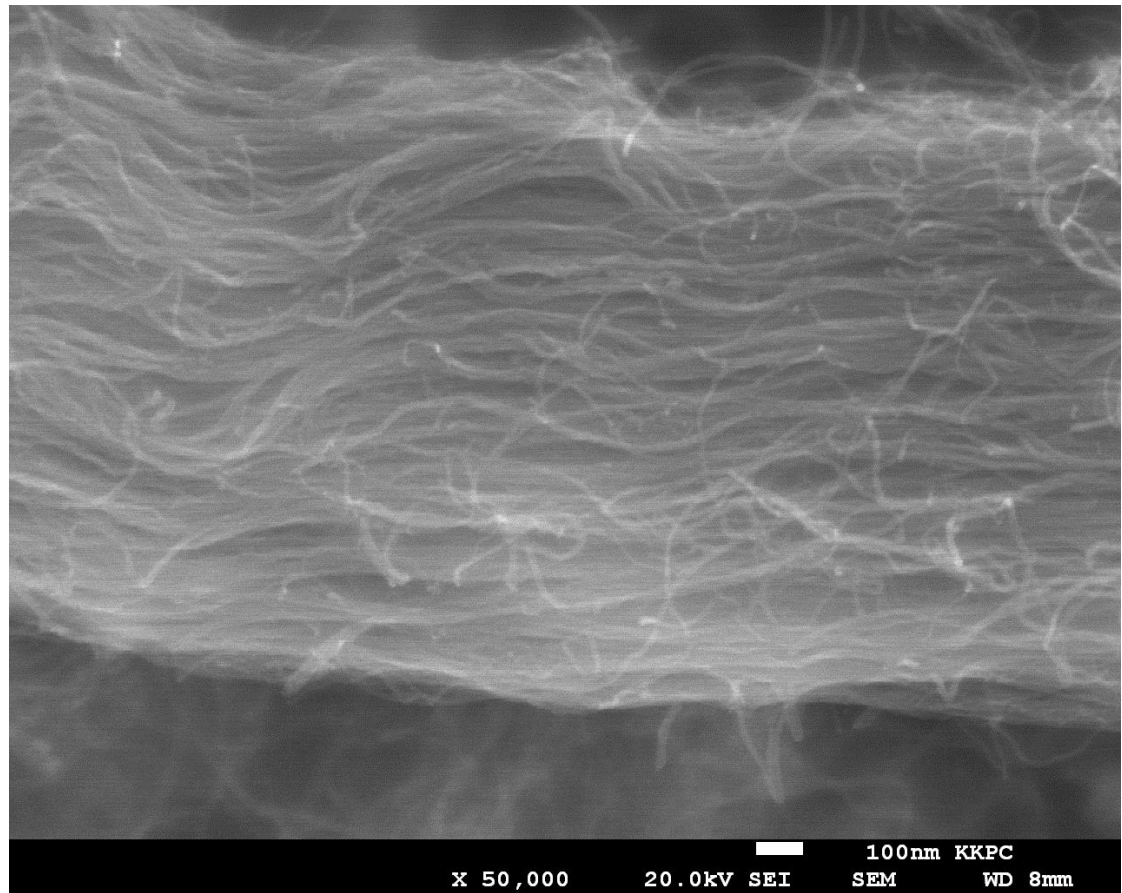


# Global Leading Chemical Group

*Beyond the best*  
KUMHO PETROCHEMICAL

# Kumho CNT (K-Nanos)



# 1

## CNT business milestone

- 1) KKPC begins CNT business as a new growth power
- 2) Manufacturing KKPC CNT Grade from MAR, 2012. : K-Nanos Series
- 3) CNT Plant for mass production
  - Location : Kumho Petrochemical Asan Electronic Plant site.
  - Operating since DEC. 2013
  - Capacity : 50MTON/year
- 4) Selling innovative Resin/CNT compounds and conductive sheet in the market (JAN, 2015)

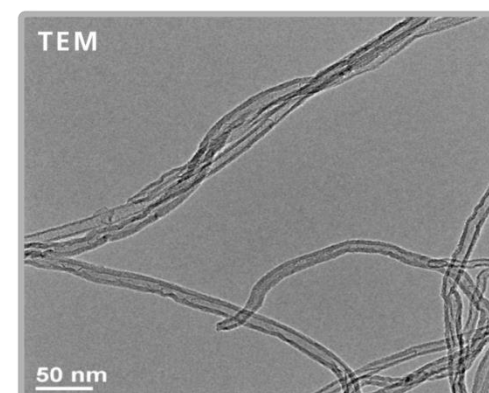
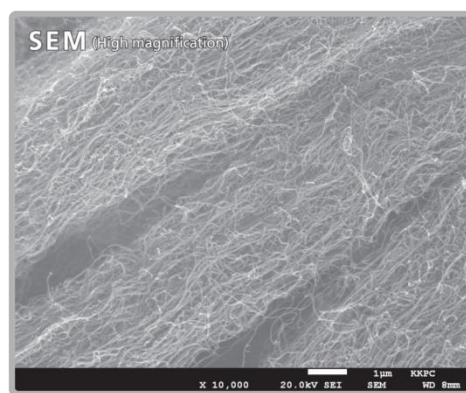




## 2

## Characteristic of Kumho CNT

Property	Unit	Value	Measurement Method
Type	-	Bundle	SEM
Bundle Diameter	$\mu\text{m}$	~3	SEM
Purity	%	96	TGA
Bulk Density (K-Nanos-100P)	g/cc	0.015~ 0.03	Tapping Method
Bulk Density (K-Nanos-100C)		0.02~ 0.05	
Bulk Density (K-Nanos-100T)		0.06~ 0.14	



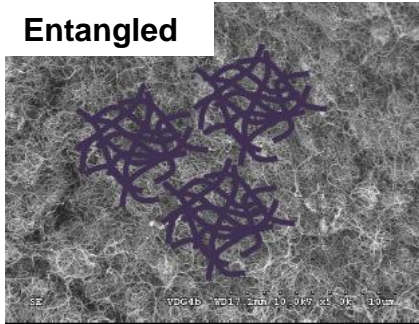
# 3

## Characteristic of Kumho CNT

Kumho CNT specially shows higher performance comparing with other CNTs due to its aligned bundle structure

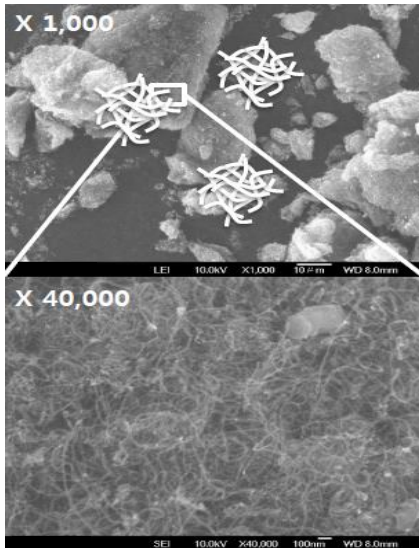
Normal CNT

Entangled



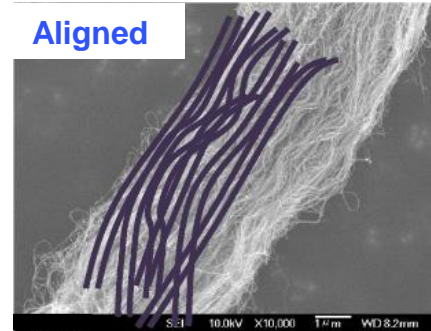
Dispersion

Bad  
Dispersion



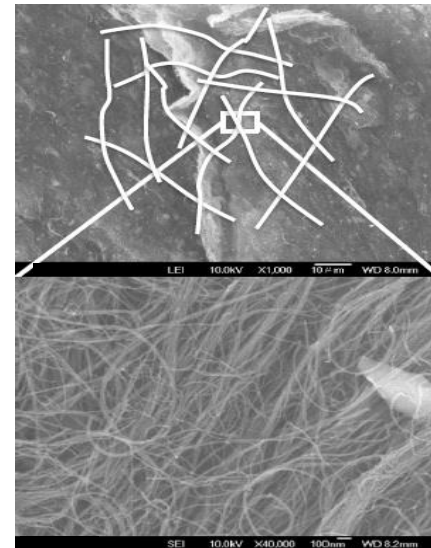
Kumho CNT

Aligned



Dispersion

Better  
Dispersion



# 4

## K-Nanos series (grades)

K-Nanos-100P  
(Powder)



Pelletizing process

K-Nanos-100T  
(Pellet)



Grinding process

K-Nanos-100C  
(Powder)

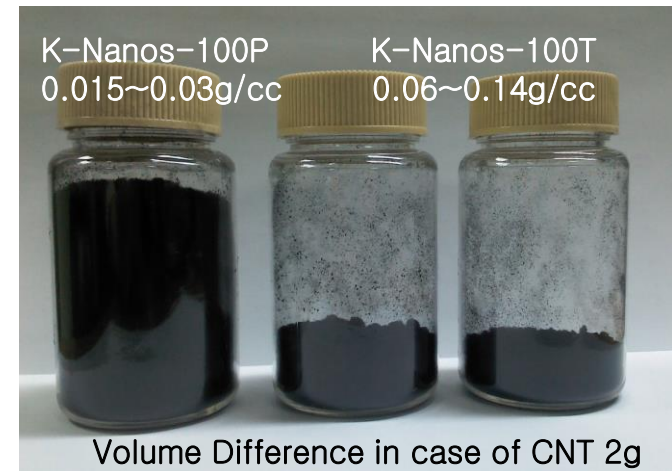


## 5 Innovative Kumho CNT\_pelletized type

Kumho makes innovative product type to improve working conditions.

### \* Advantages of K-Nanos-100T

- improve **works efficiency** for CNT composite
- **solve inhalation problems** by reducing scattering in the air.
- **Yield up** (input fixed amount, minimize Loss)
- **Convenient storage and transport** by decreasing volume



K-Nanos-100P



K-Nanos-100T

Diameter : 4Ø(Variable)  
Thickness : 2mm(Variable)

K-Nanos-100T

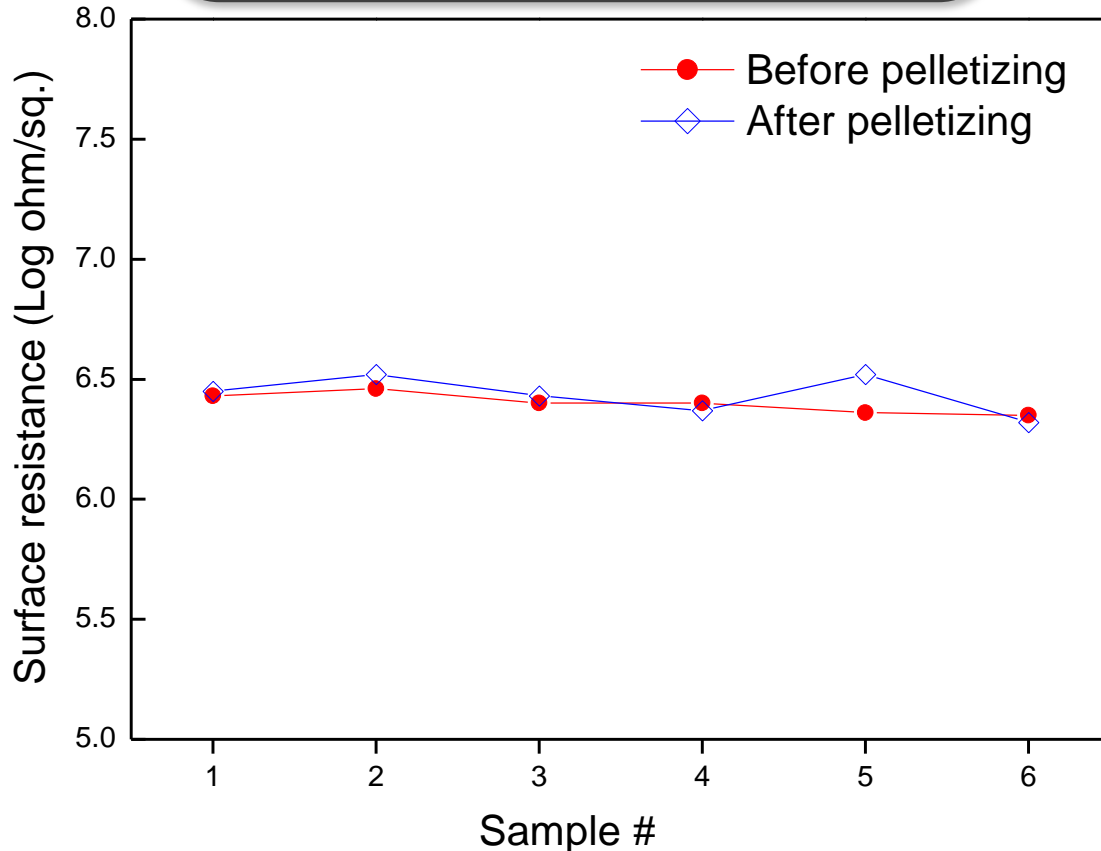


Patented

# 6 K-Nanos-100T (electrical conductivity)

Show same performance of electrical conductivity comparing powder and tablet type CNT  
We recommend side-feeding method for this Tablet type product.  
Customer can enjoy the side-feeding options using this product

PC/ABS/CNT (1.5phr) composite

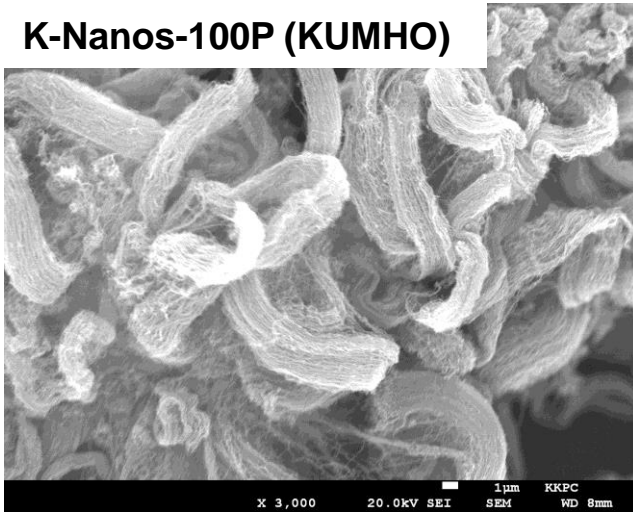


Not too much  
differences in electrical  
conductivity before &  
after treatment  
Between powder type  
and tablet type.

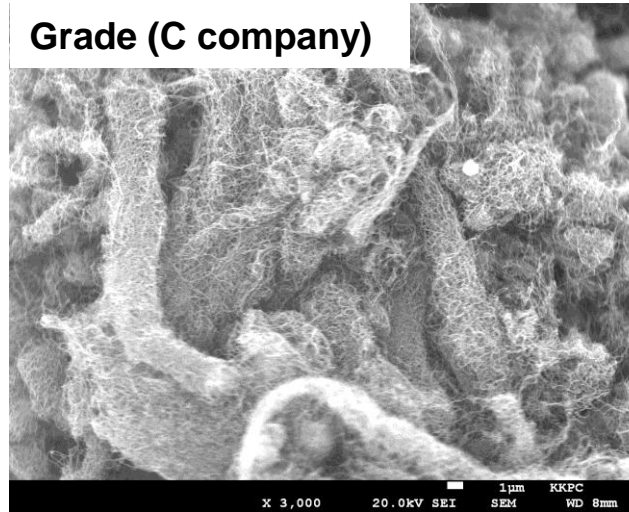


# 7 K-Nanos series (performance test)

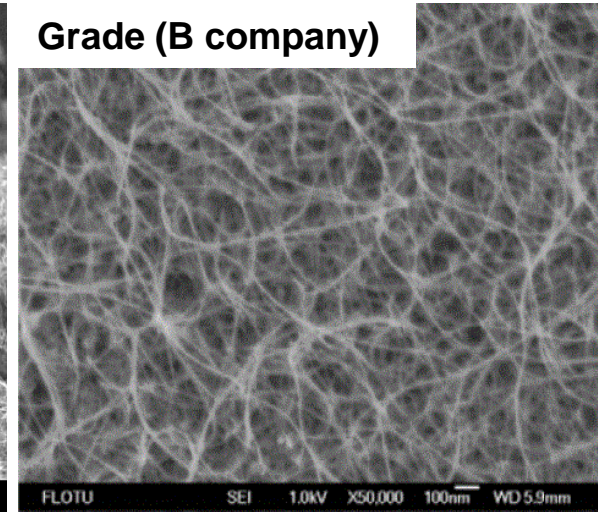
K-Nanos-100P (KUMHO)



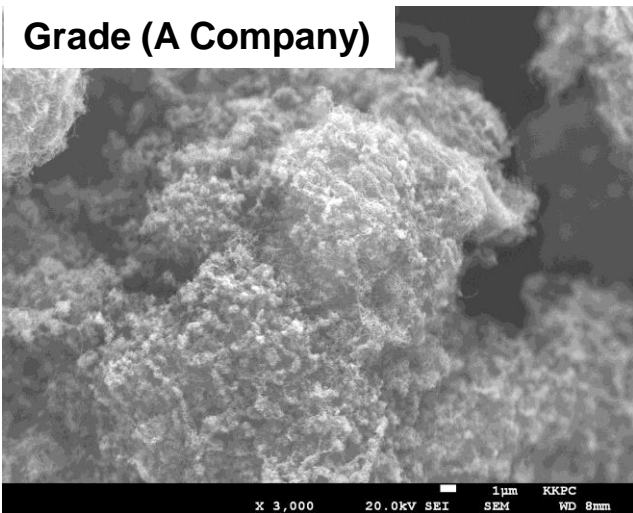
Grade (C company)



Grade (B company)



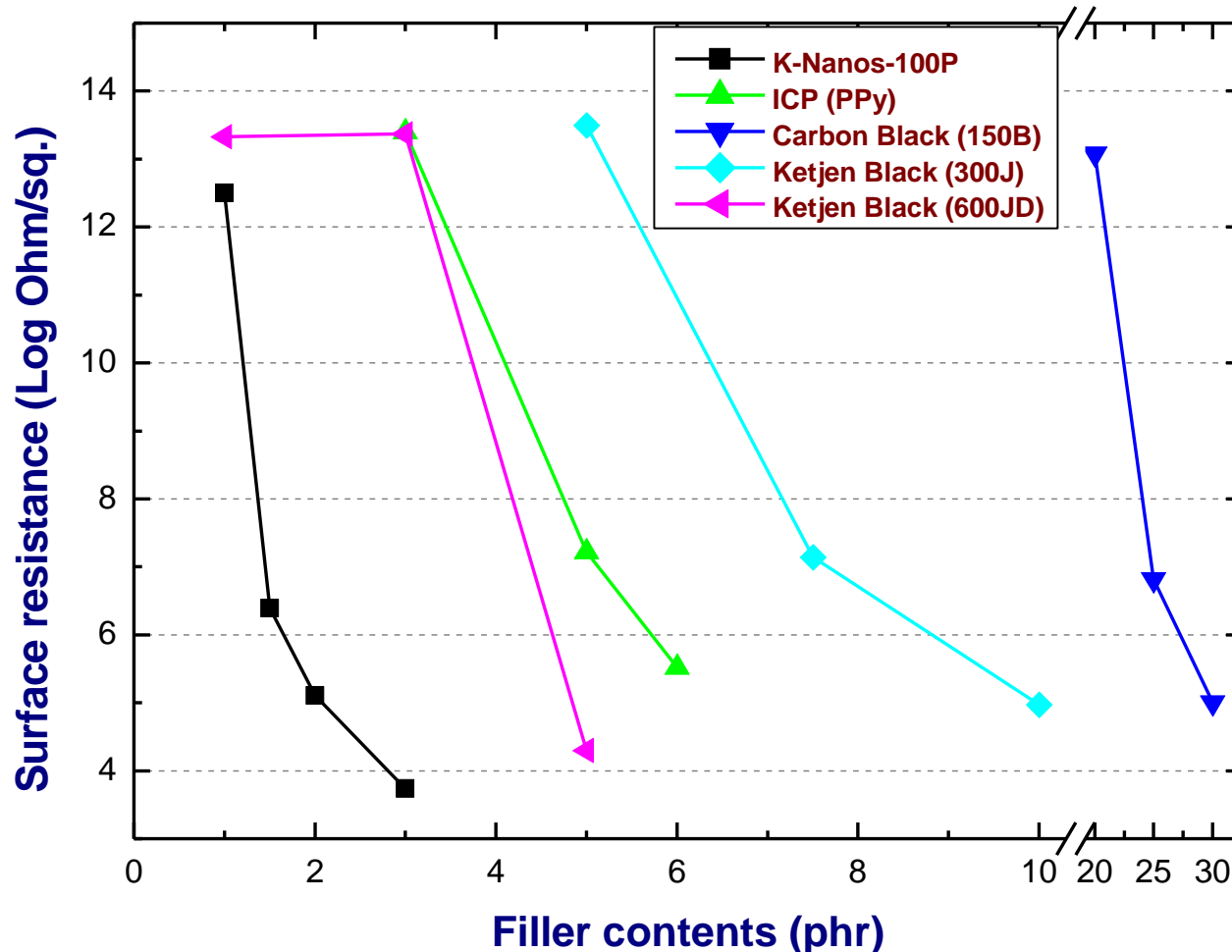
Grade (A Company)



	CNT type	Carbon purity (%)	Surface resistivity (Log ohm/sq.) PC/ABS/CNT (1.5Phr)
K-Nanos-100P (KUMHO)	Highly aligned bundle	95.0	6.39
Grade (C company)	Aligned bundle	89.6	7.42
Grade (B company)	Entangle	97.1	13.13
Grade (A company)	Entangle	84.6	13.48

# 8 K-Nanos series (performance test)

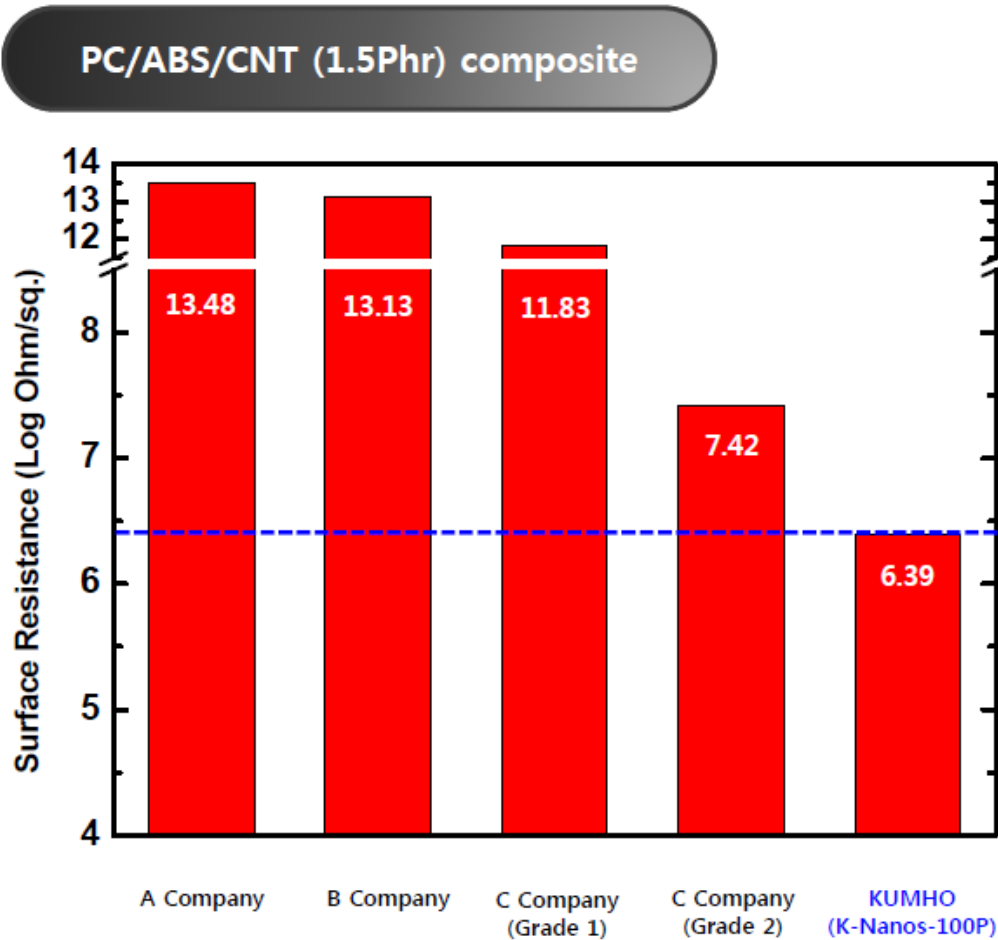
Data of electrical conductivity for PC/ABS/conductive filler composites



Coductive filler	Filler contents (Phr)
K-Nanos-100P	1, 1.5, 2, 3
ICP (PPY)	3, 5, 6
Carbon Black (150B)	20, 25, 30
Ketjen Black (300J)	5, 7.5, 10
Ketjen Black (600JD)	1, 3, 5

## 8 K-Nanos series (performance test)

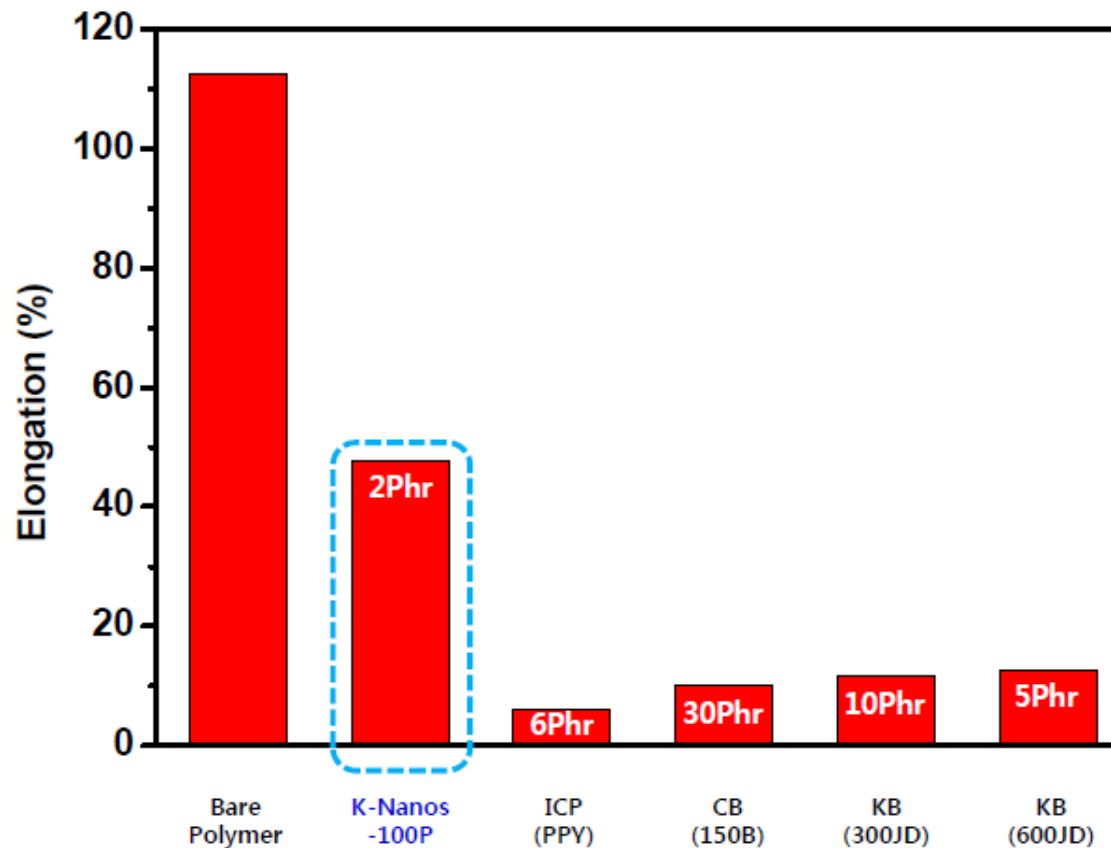
### ■ The Result of Testing PC/ABS Compounding



## 8 K-Nanos series (performance test)

### ■ The Result of Testing PC/ABS Compounding

Data of Elongation (ER) for PC/ABS/Conductive filler composites

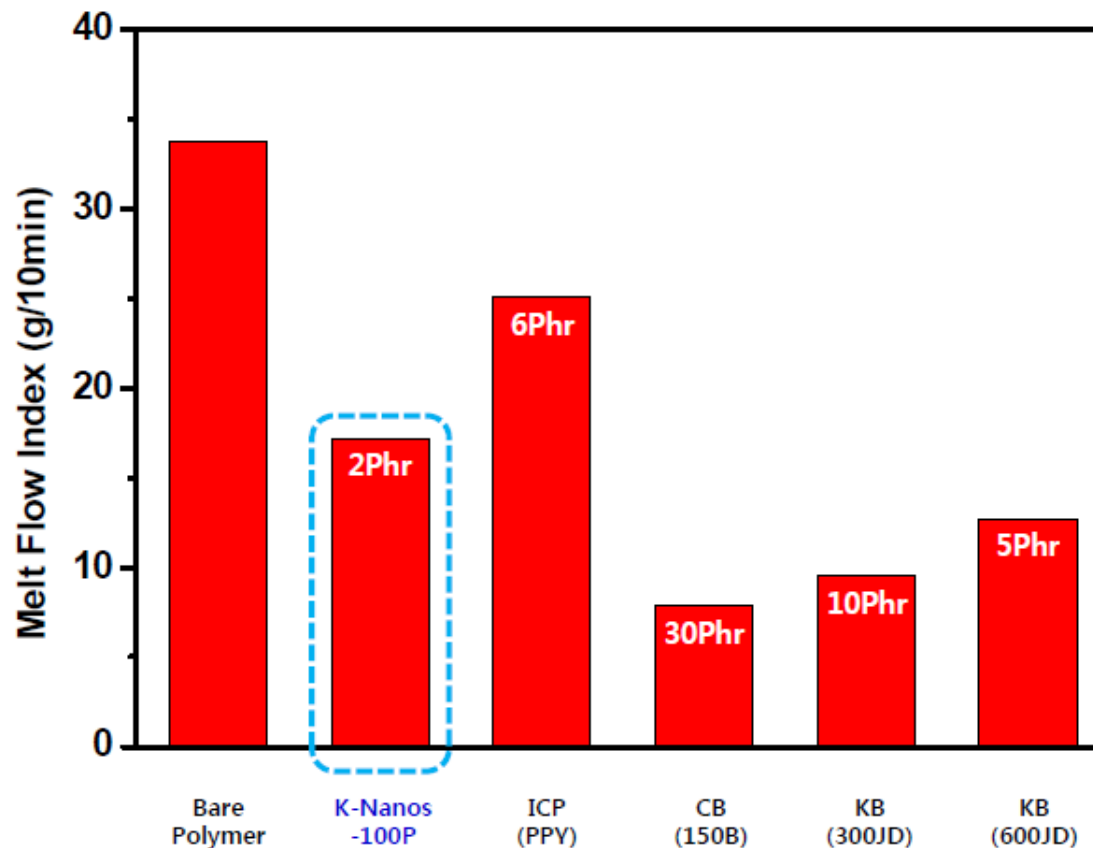




## 8 K-Nanos series (performance test)

### ■ The Result of Testing PC/ABS Compounding

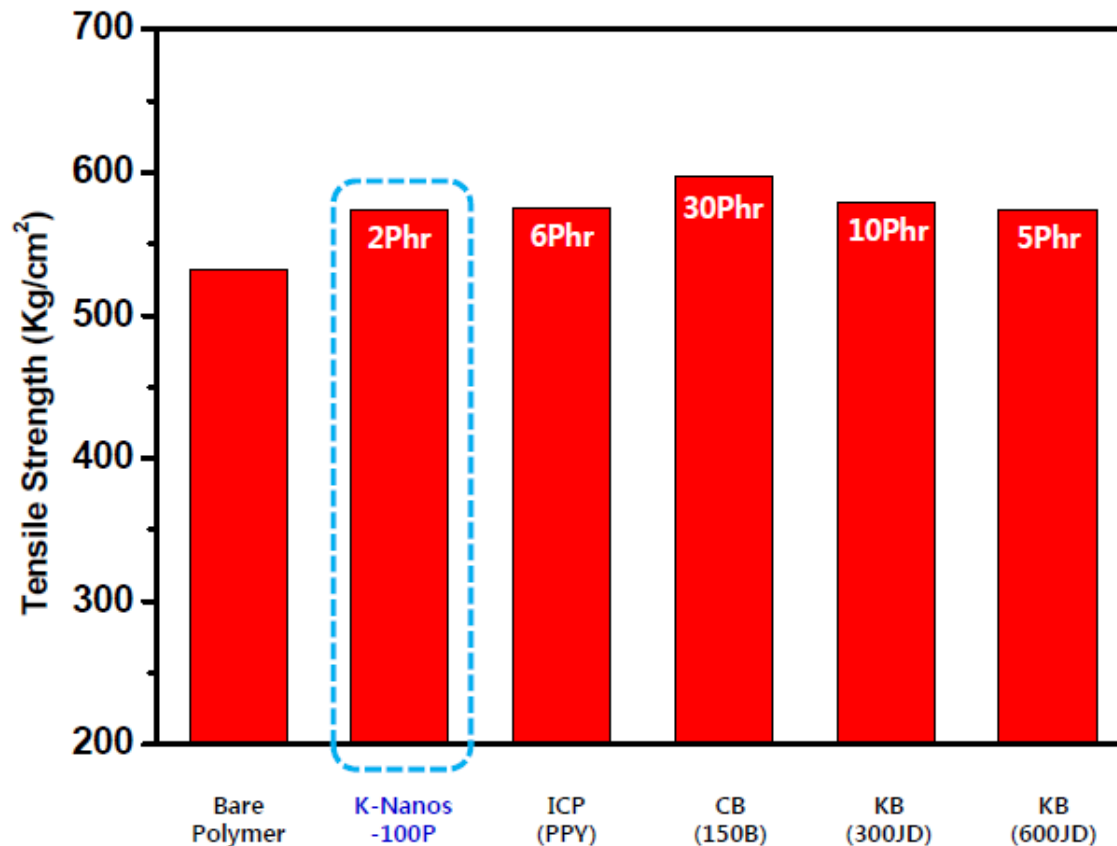
Data of Melt Flow Index (MI) for PC/ABS/Conductive filler composites



## 8 K-Nanos series (performance test)

### ■ The Result of Testing PC/ABS Compounding

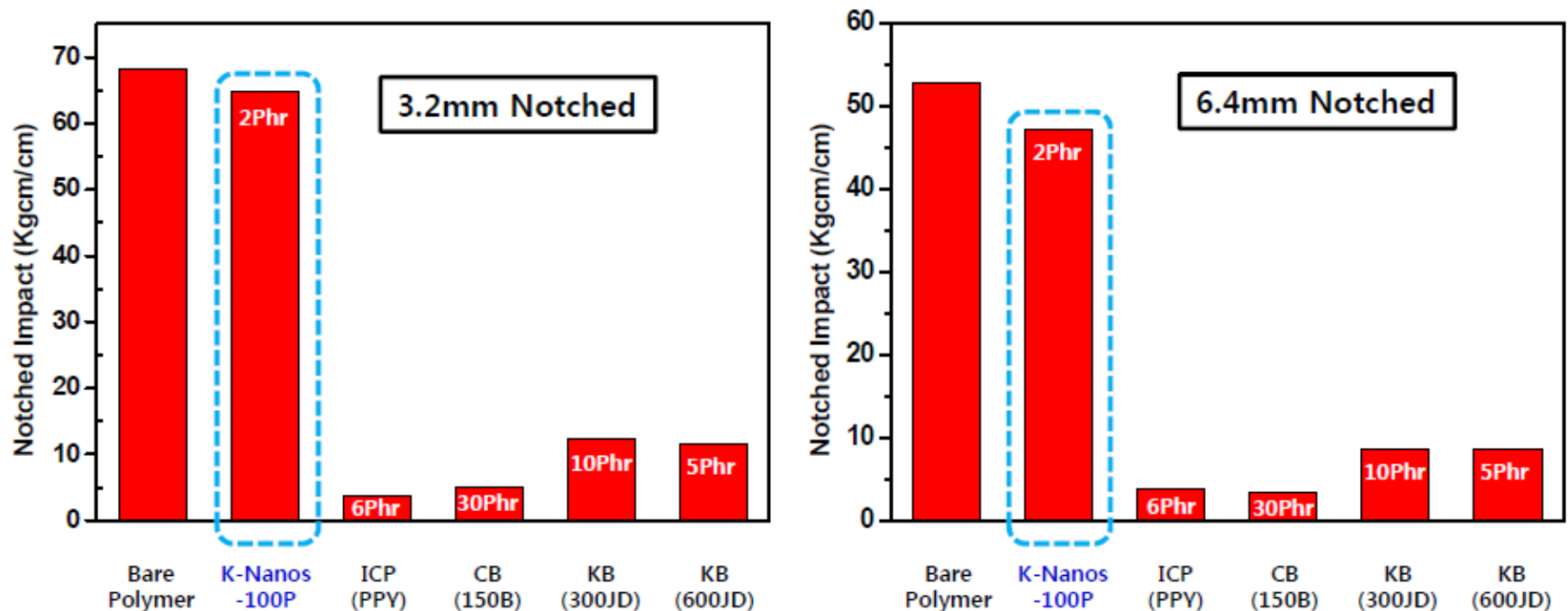
Data of Tensile Strength (TS) for PC/ABS/Conductive filler composites



## 8 K-Nanos series (performance test)

### ■ The Result of Testing PC/ABS Compounding

Data of Notched Impact (NI) for PC/ABS/Conductive filler composites





# Thank you