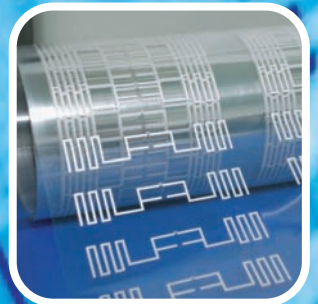
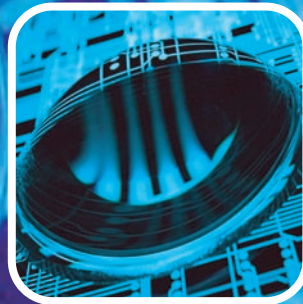
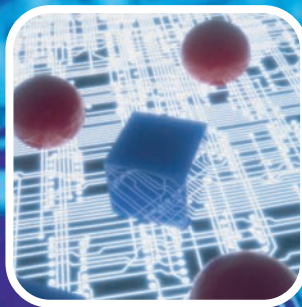


Nano Technology Products

Nano-Pia



npk



Total Solutions For Nano Technology

NPK Co.,Ltd. (former Nippi Korea Co., Ltd.) was established in 1987 as a joint venture with Nippon pigment in Japan.

Our major products are the plastic compounds and the master batches. From these products, we have developed the dispersion technology of pigments. Now, on this dispersion technology foundation, we develop nano technology with nano chemistry.

Our nano products, named Nano-Pia, include the anti-bacterial solution, the conductive ink, the nano metal particle solution, and the nano- sized pigment.

■ Kumi Factory



■ Pyeongtack Factory

Nano-Coln
Conductive Ink

Nano-Des
Anti-bacterial Solution



Nano-Me
Nano Metal Solution

Nano-Pig
Nano-sized Pigment

Brief History

1987.	3	Established Nippi Korea Co., Ltd.
1987.	7	Opened factory at Kumi.
1998.	12	Obtained ISO 9001 Quality System.
2000.	2	Name changed to NPK Co., Ltd.
2000.	10	Registered with KOSDAQ.
2001.	12	Takeover Yoochang Tech, an injection molding company.
2002.	11	Obtained ISO 9001;2000 Quality System.
2005.	3	Takeover Kostec, a master batch company.
2007.	7	Opened factory at Pyeongtack.

Nano-Coln

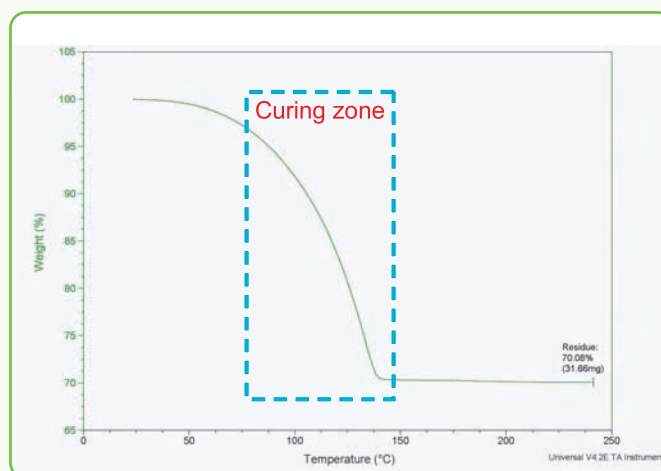
“Nano-Coln” is the brand name of conductive ink.

■ Nano-Coln Characteristics

- High Silver Concentration : 40~90 wt%
- Low Curing Temperature : less than 110°C, printable on PET film
- Excellent Electronic Property : specific resistance $< 5 \times 10^{-6} \Omega \text{ cm}$
- Variety of Printing Method : screen to gravure printing

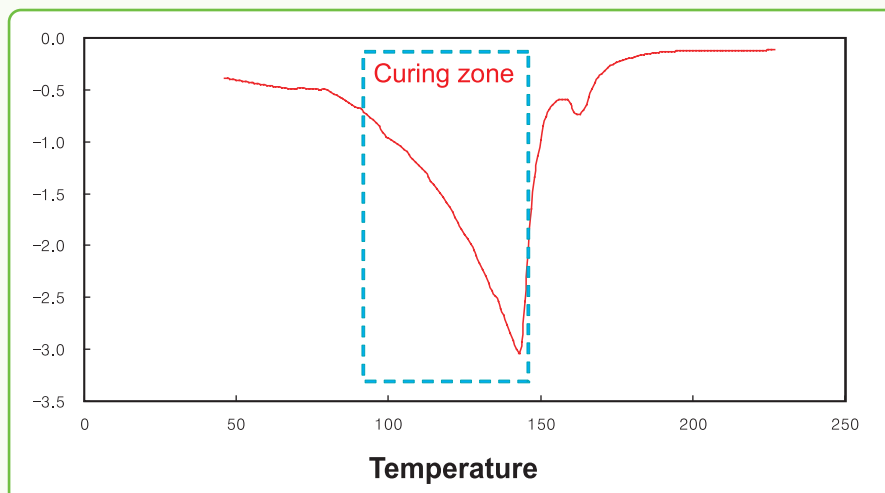
■ TGA Result

- Silver Concentration \approx 70 wt%
- Curing Temperature : 100~140°C



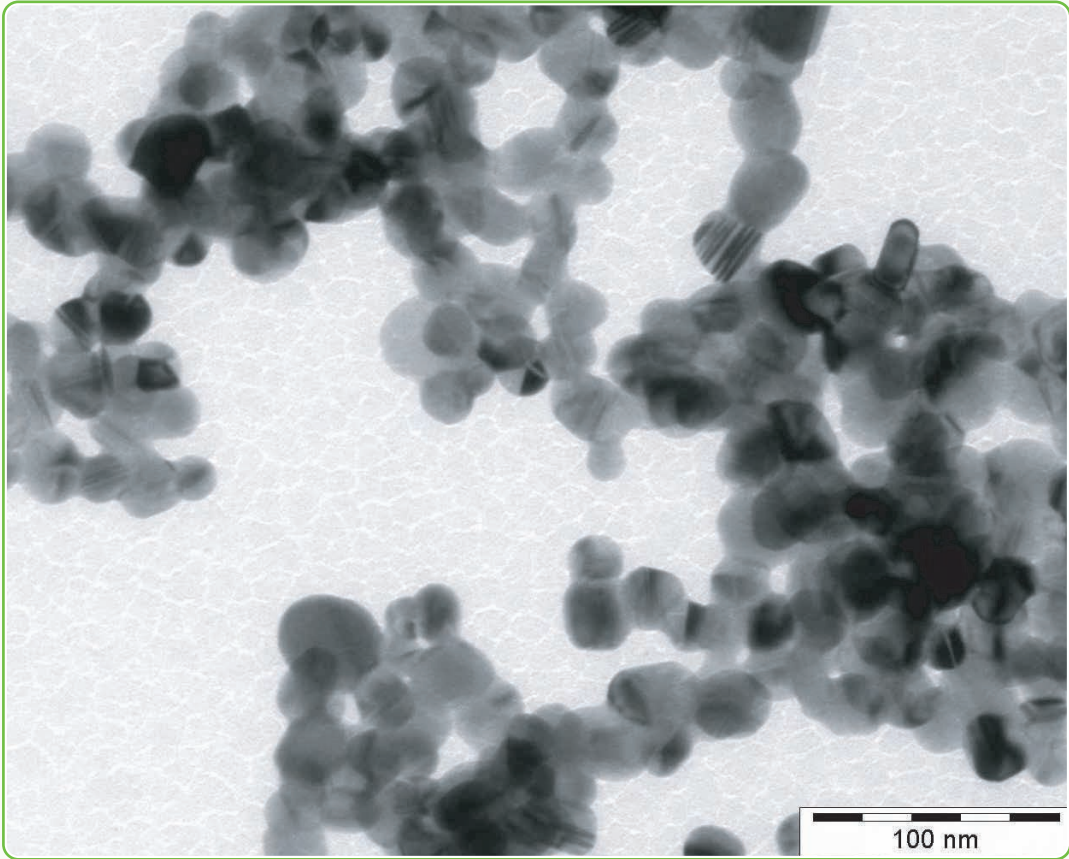
■ DSC Result

- Curing Temperature : 100~140°C



■ TEM Image

• Primary Particle Size : 20~50nm



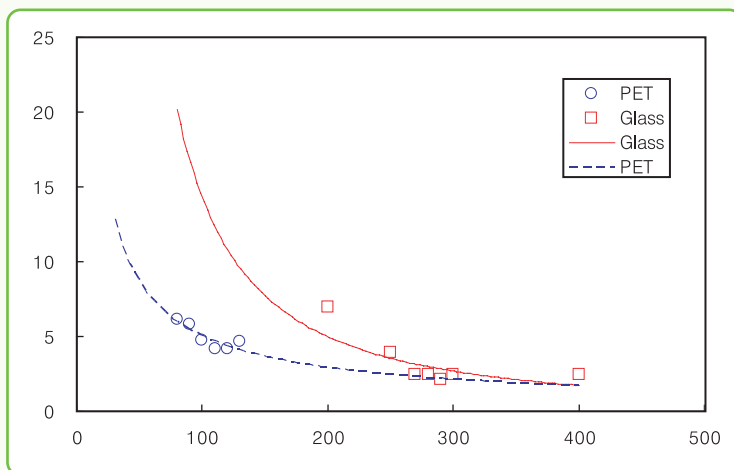
■ Electronic Properties

Property	Unit	Result
Curing Thickness	μm	1.3
Surface Resistance	Ω	3.1×10^{-2}
Specific Resistance	$\Omega \text{ cm}$	3.9×10^{-6}

Nano-Coln

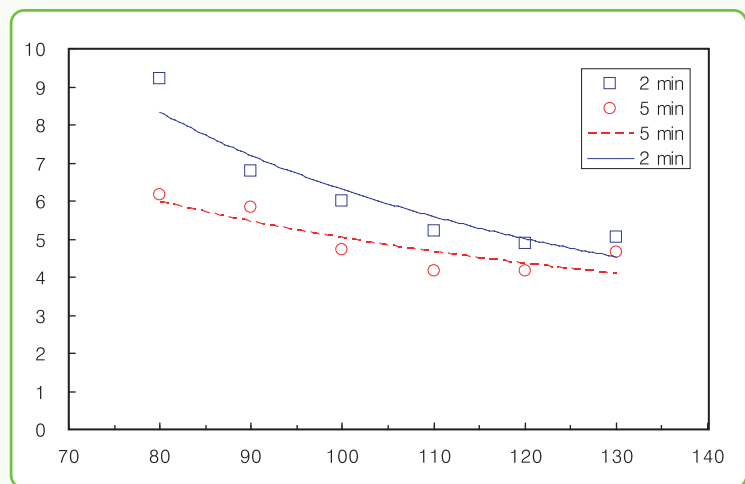
■ Specific Resistance

- Depending on curing temperature and time, $2.5 \sim 5 \times 10^{-6} \Omega \text{ cm}$



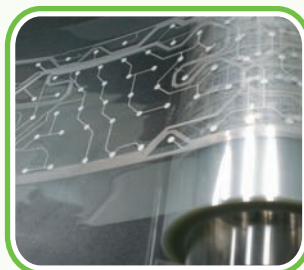
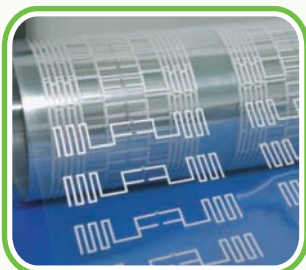
Effect of curing temperature

Effect of curing time



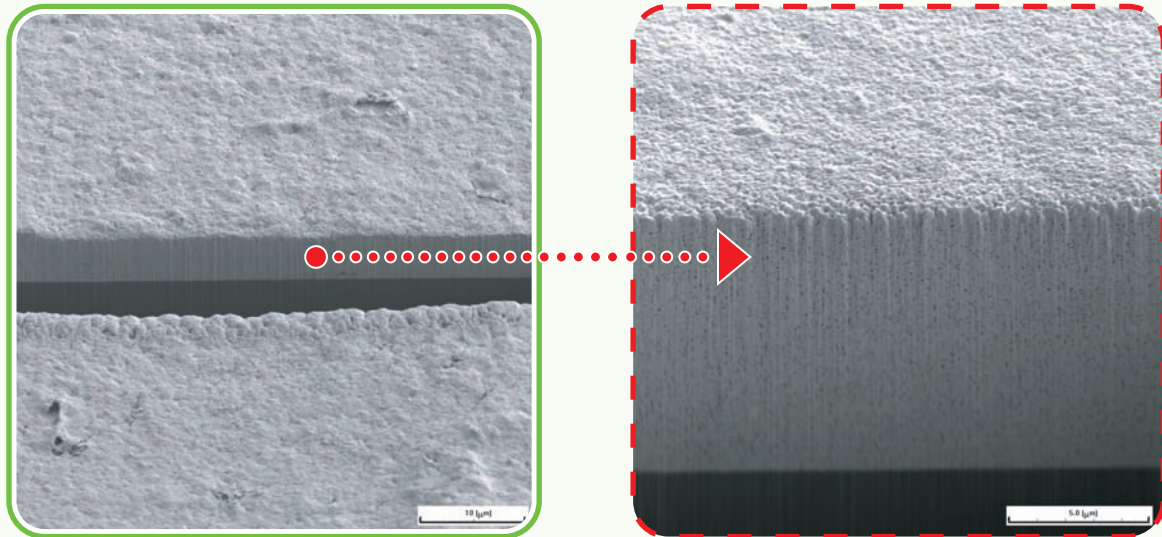
■ Printed Examples

- By screen printing



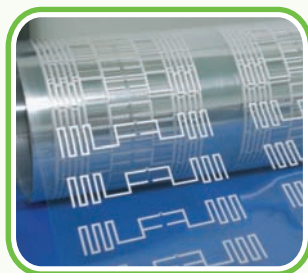
■ SEM Images

- It is easy to find low temperature sintering.



■ RFID Application Example

- Similar antenna performance



Etching / Cu

Screen Printing / Ag



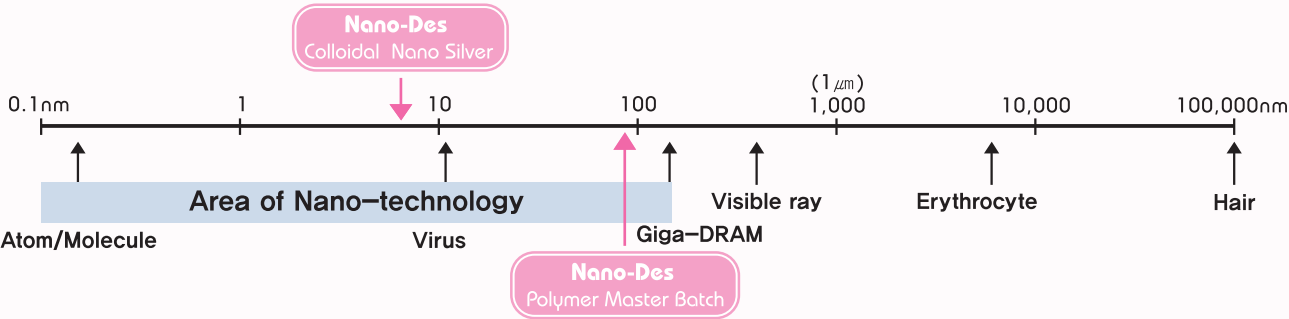
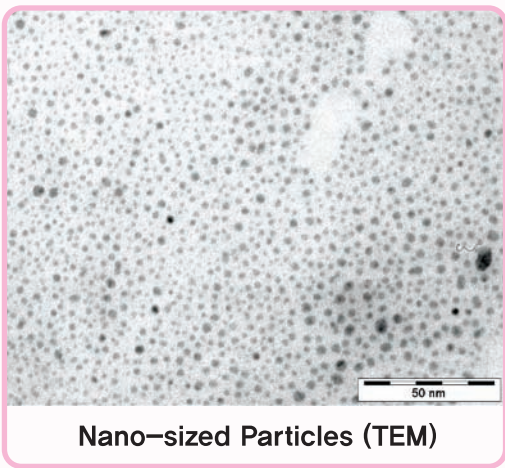
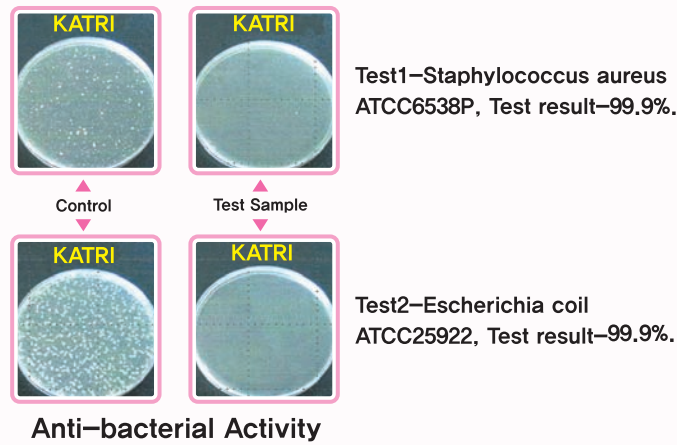
Nano-Des

“Nano-Des” is the brand name of anti-bacterial ‘Colloidal Nano Silver’ & it’s ‘Polymer Master Batch’.

■ Nano-Des Characteristics

Colloidal Nano Silver	Polymer Master Batch
Anti-bacterial solution 2~15nm size Non-harmful High dispersion Technology	Anti-bacterial master batch Variety of polymer applications High dispersion Technology Efficient at low concentration

■ Anti-bacterial Activity & Particle size



■ Anti-bacterial Test

• Colloidal Nano Silver

Solvent	Silver Concentration (ppm)	Bacteriostatic Reduction Rate(%)		Test Method	Remark
		Staphylococcus aureus	Escherichia coli		
Water	100~100,000	99.9	99.9	KS M 0146-2003	Particle size 2~15nm
Bu-OH	100~100,000	99.9	99.9		
PEG	100~100,000	99.9	99.9		

• Polymer Master Batch

Resin	Silver Concentration (ppm)	Bacteriostatic Reduction Rate(%)		Loading ratio	Test Method
		Staphylococcus aureus	Escherichia coli		
PP	1,000~2,000	99.9	99.9	5~10 (%)	JIS Z 2801-2000
PE	1,000~2,000	99.9	99.9		
ABS	1,000~2,000	99.9	99.8		
PET	1,000~2,000	98.7	98.6		
PA6	500~1,000	99.9	99.9		
PVC	1,500~3,000	99.9	99.9		

The type of solvent, resin, and silver concentration can be adjusted upon requests from customers.

■ Toxicity Test

TEST REPORT

1761, Songwon 2-Dong, Seong-Gu, Seong, Korea TEL: 82-53-284-1910 FAX: 82-53-284-1915

Report No.: NDS-2020-0001 Test Date: Jun. 27, 2020

Client Name: Sang-Gu, Choi
Name of Company: NPK Co., Ltd.
Client's Address: 1002-16, Super-dong, Seong-Gu, Kyungju, Korea

Sample Name: Colloidal Nano Silver

TEST ITEM	UNIT	SAMPLE	RESULT	TEST METHOD
Biocompatibility	-	1	+	OECD guideline for testing (ISO 10993-5, 10993-10)

* It was estimated that toxic material of Colloidal Nano Silver (1000 ppm) did not cause any irritation response in the skin of rabbits, and thus test article was considered to be non-irritating material.

Attachment: Final Report

NOTE: 1. The test results of this test report only limited to the sample and sample name presented by the client and do not guarantee the all products of the client.
2. This test report shall be used only within the purpose of its defined scope and shall not be used for public relation, advertisement and such without the KTR's written approval.

Testing Personnel: Kim Dong-Hyun (82-53-284-1910) Technical Manager: Song Hee-Jung
Jun. 28, 2020 *Hu J. Sung*
DIRECTOR GENERAL, KOREA TESTING & RESEARCH INSTITUTE
1 of Total: 1 Page(s) *Bo Wen. Lee*

Skin

TEST REPORT

1761, Songwon 2-Dong, Seong-Gu, Seong, Korea TEL: 82-53-284-1910 FAX: 82-53-284-1915

Report No.: NDS-2020-0002 Test Date: Jun. 27, 2020

Client Name: Sang-Gu, Choi
Name of Company: NPK Co., Ltd.
Client's Address: 1002-16, Super-dong, Seong-Gu, Kyungju, Korea

Sample Name: Colloidal Nano Silver

TEST ITEM	UNIT	SAMPLE	RESULT	TEST METHOD
Acute toxicity (LD50)	-	1	+	OECD guideline (OECD 401)

* The Colloidal Nano Silver showed no adverse reaction toxicity response in treated animal at 2,000 mg/kg B.W. body weight. But acute toxicity was not observed for test period.
Therefore, the Colloidal Nano Silver was estimated to be UNDESIRABLY HARMFUL (OECD class 5) in this study.

* Attachment: Test Report

NOTE: 1. The test results of this test report only limited to the sample and sample name presented by the client and do not guarantee the all products of the client.
2. This test report shall be used only within the purpose of its defined scope and shall not be used for public relation, advertisement and such without the KTR's written approval.

Testing Personnel: Jung Dong-Hyun (82-53-284-1910) Technical Manager: Song Hee-Jung
Jun. 27, 2020 *Hu J. Sung*
DIRECTOR GENERAL, KOREA TESTING & RESEARCH INSTITUTE
1 of Total: 1 Page(s) *Bo Wen. Lee*

Oral

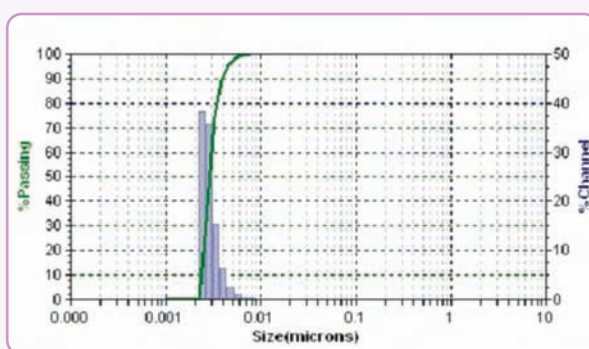


Nano-Me

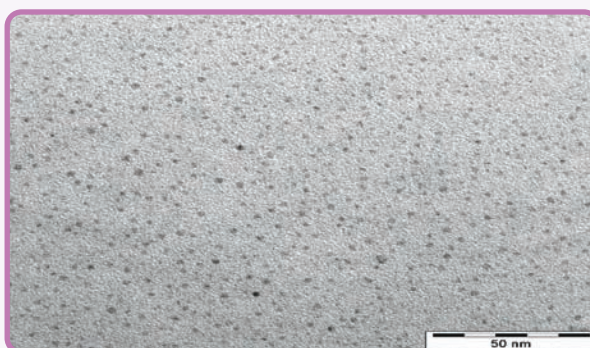
“Nano-Me” is the brand name of nano-sized metal solution. Nano-Me includes the nano-sized metal of Silver, Copper, Iron, Tin, Nickel, Zinc, and Cobalt.

■ Nano Copper

Particle Size Distribution



Nano-sized Particles (TEM)



■ Nano-Me Characteristics

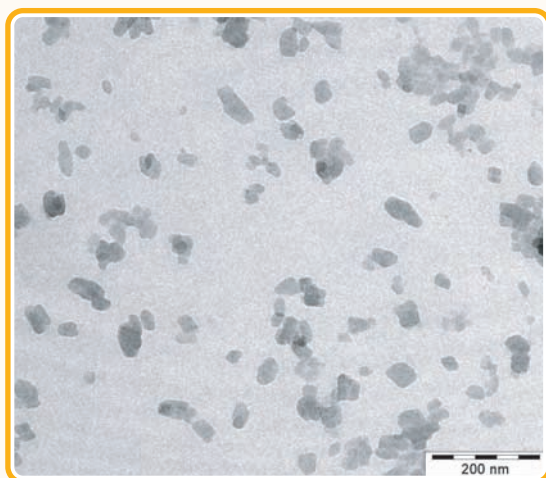
Nano Metal	Particle Size	Concentration	Color	Solvent	pH
Silver	2~10nm	< 12wt%	Red	PEG, EG, Water	4±0.5
Copper	1~7nm	< 12wt%	Green	PEG	4±0.5
Iron	2~20nm	< 10wt%	Red	Water	2±0.5
Tin	2~10nm	< 3wt%	Yellow	DMF	5.5±0.5
Nickel	2~10nm	< 10wt%	Sky-Blue	PEG	4±0.5
Zinc	2~20nm	< 12wt%	Yellow	PEG	3±0.5
Cobalt	2~30nm	< 10wt%	Red	PEG	3±0.5



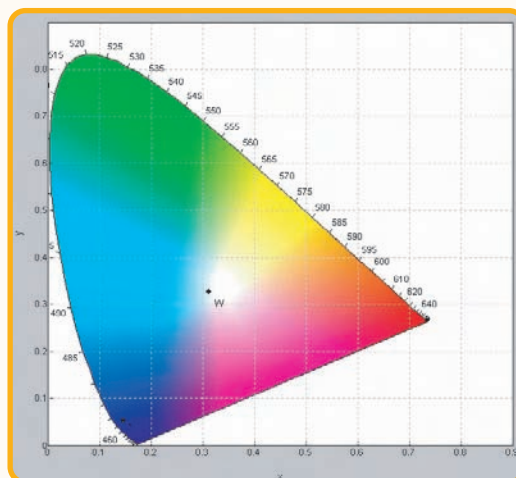
Nano-Pig

“Nano-Pig” is the brand name of nano-sized pigment. We have equipments for the mill base for color filter in LCD and for plastic applications. Nano-Pig could improve color strength and long term stability, provide better transparence, and reduce the amount of pigment loading.

■ Mill Base for Color Filter in LCD

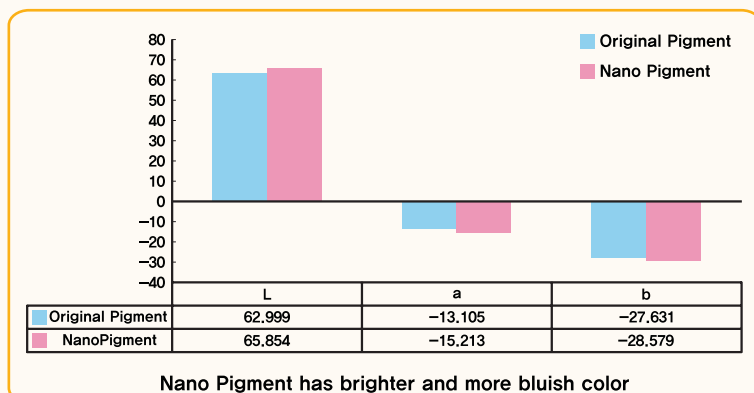


TEM Picture



Color Coordinate

■ For Plastic Application



Nano Pigment has brighter and more bluish color

