

계면활성제를 이용한 나노 소재의 합성과 응용

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계면활성제를 이용한 나노 소재의 합성과 응용



September 23, 2004

Dr. Seung-Kyu Park


LG Household & Healthcare



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 I. What is nanotechnology?

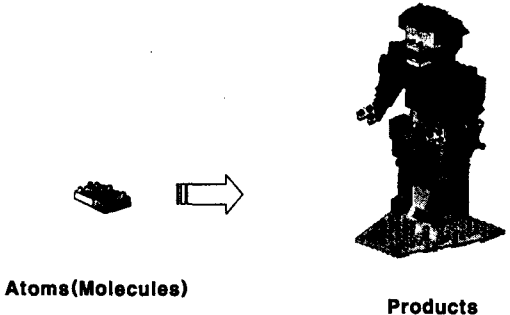
NT for clean, beautiful and healthy life

1. What is nanotechnology?

 I. What is nanotechnology?

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Nanotechnology is the creation and utilization of functional materials, devices and systems with novel properties that are achieved through the control of matter at the molecular level.
-1 nm = 10^{-9} m, 1/50,000 of thickness of human hair



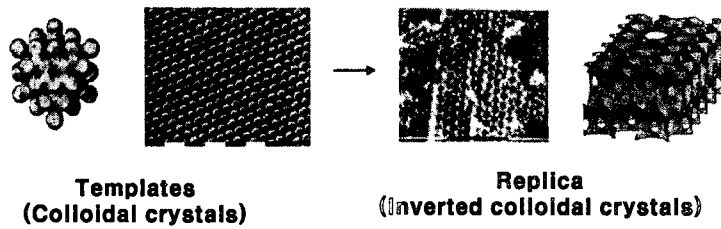
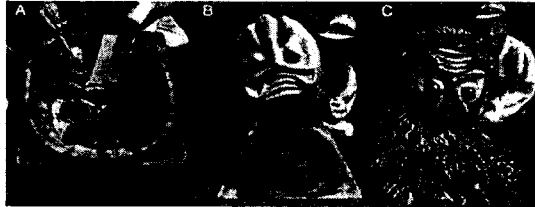
Atoms(Molecules) **Products**



1. What is nanotechnology?

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▣ Template synthesis



2. Discovery of nanotechnology

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2. Discovery of Nanotechnology

2. Discovery of nanotechnology

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Ref) Beck, J. S., et al. *J. Am. Chem. Soc.*, 1992, 114, 10834.

Ref) Zhao, D., et al. *J. Am. Chem. Soc.*, 1998, 120, 6024. Ref) Ryong, Y., et al. *Advanced materials*, 2001, 13, 677.

2. Discovery of nanotechnology

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Nano particles

$Cd_{1-x}Mn_xS$
Ref) Lévy, L., et al. *J. Phys. Chem. B* 1997, 101, 9153

$Cd_{1-x}Zn_xS$
Ref) Cizerón, J., et al. *J. Phys. Chem. B* 1997, 101, 8887

Ag_2Se
Ref) Buschmann, V., et al. *Langmuir* 1998, 14, 1528

Cu_2S & CuS
Ref) Dixit, S. G., et al. *Colloid. Surf. A* 1998, 133, 69

$AgCl$
Ref) Ragwe, R. P., et al. *Langmuir* 1997, 13, 6432

Copper nano particles
(8 - 16 nm)
Ref) Cason J. P., et al. *J. Phys. Chem. B*, 2001, 105, 2297

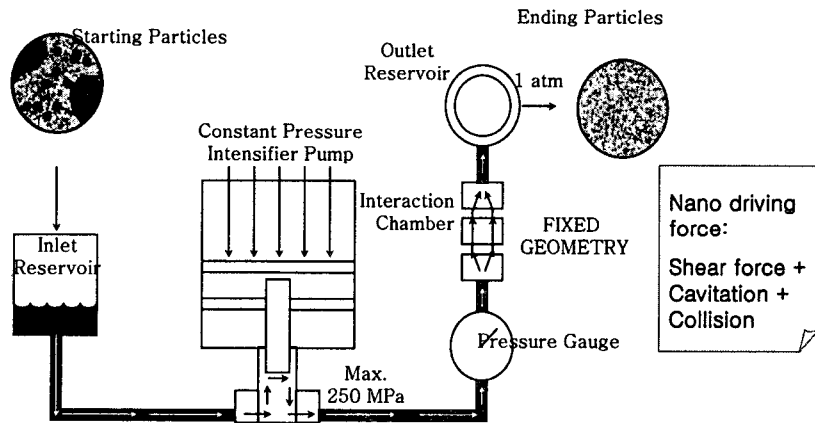
Isooctane

Nano particle



2. Discovery of nanotechnology

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3. NCB, Synthesis & Products

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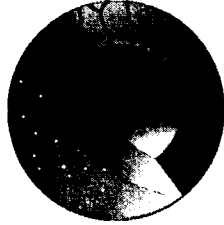
3. Nano Carbon Ball, Synthesis & Products



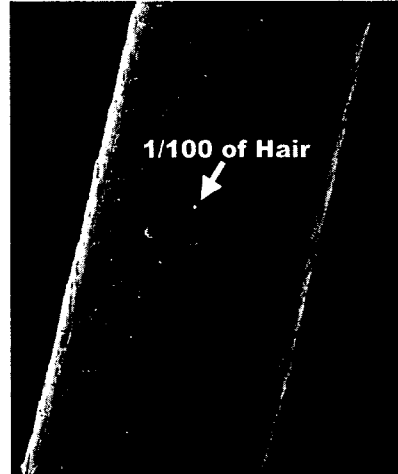
3. NCB, Synthesis & Products

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Origin of Nano Carbon Ball



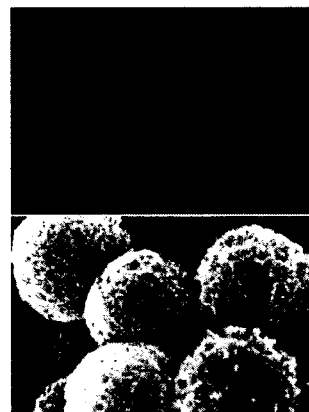
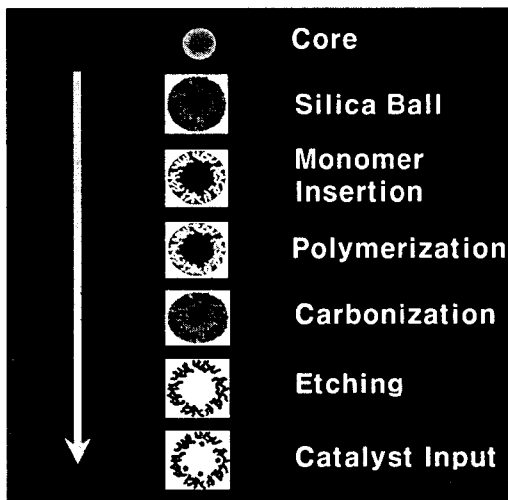
- Advanced Materials, 2002



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Synthesis of Nano Carbon Ball



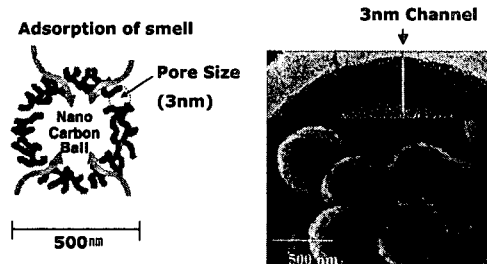


3. NCB, Synthesis & Products

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Nano Carbon Ball

- New Carbon materials with 500nm diameter
- Nano technology application
- LG unique nano-structured deodorization material commercialized for the first time in the world
- Wall thickness & pore size control: Adsorption capacity maximize
- Catalyst immobilization in hollow core or pore: Decomposition performance up



3. NCB, Synthesis & Products

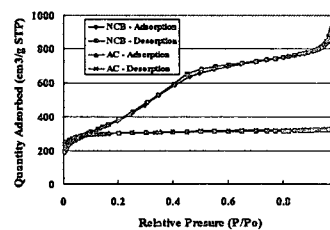
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Physicochemical Properties of NCB

	NCB	Remarks
Core diameter	150~250 nm	Ave. 200 nm
Shell thickness	50 ~ 200 nm	Ave. 180 nm
BET surface area	1450 m ² /g	1.5~2 Times of AC
Mesopore area	878.3 m ² /g	6 Times of AC
Pore volume	1.27 cm ³ /g	3 Times of AC
Pore size	3 nm	Peak value

AC: Activated Carbon

N₂ Adsorption Analysis

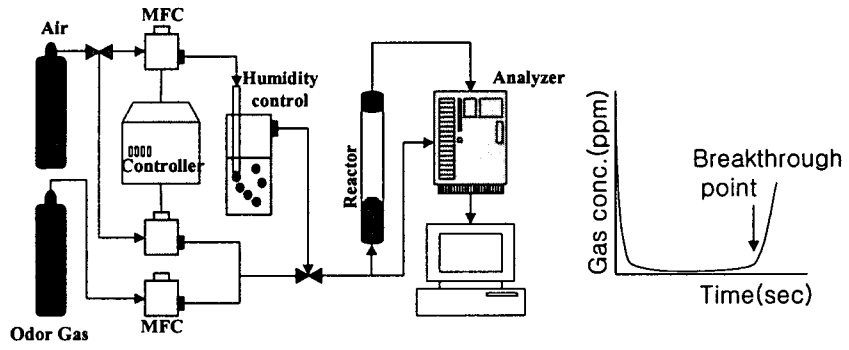




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Deodorization Test (Breakthrough capacity method, ASTM D 6646)

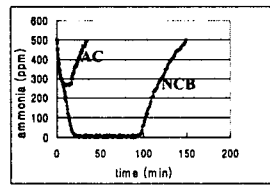


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Test Result (Breakthrough capacity method, ASTM D 6646)

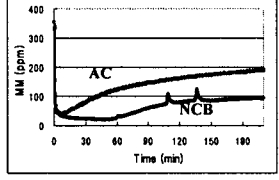
Ammonia



(SMPL:
0.1g AC: 0.1g NCB,
Ammonia 500 ppm,
Flow rate: 200 ml/min)

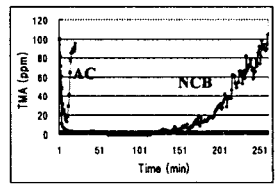
Malodor

Methyl mercaptan

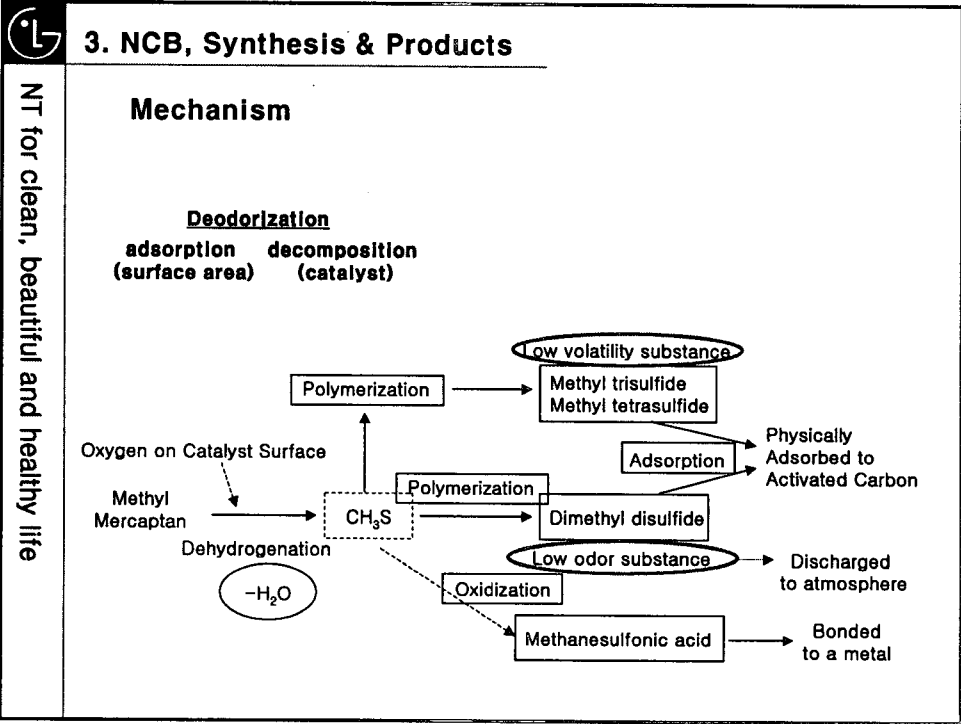
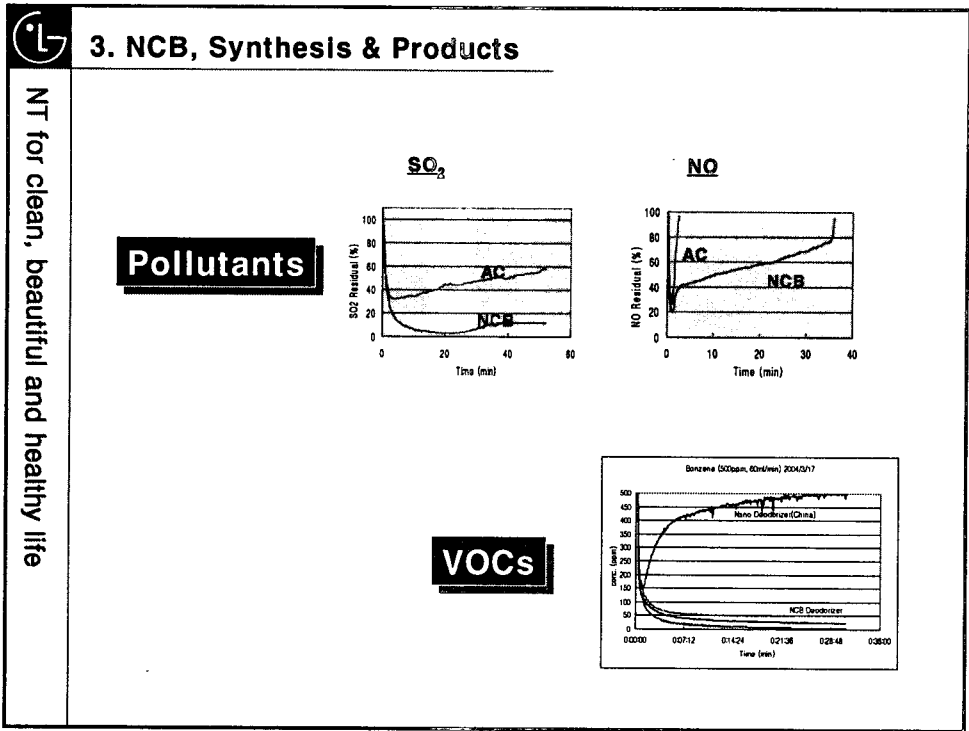


(SMPL:
0.1g AC: 0.1g NCB,
Methyl Mercaptan 500 ppm,
Flow rate: 100 ml/min)

Trimethylamine



(SMPL:
0.1 g, AC: 0.1g NCB,
TMA 100 ppm,
Flow rate: 200 ml/min)



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3. NCB, Synthesis & Products

Mechanism

$2 \text{CH}_3\text{SH} \longrightarrow \text{CH}_3\text{S}-\text{SCH}_3$
 Slowly in the air
 Quickly with catalyst

2 CH₃SH
MM
Strong odor

CH₃S - SCH₃
DMDS
Low odor

CH₃SO₃H
MS acid
Odorless

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3. NCB, Synthesis & Products

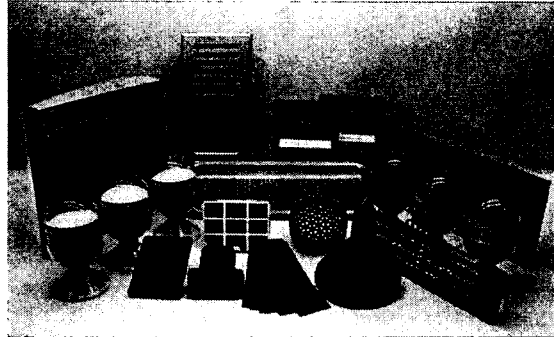
Products Line Up

NCB Bead	NCB Mesh	NCB Sheet	NCB Cabin	NCB Honeycomb	NCB Urethane Foam
Encapsulated thousands of NCB into gelatin capsules (diameter: 1-5 mm) Polymer binder, capsules with porous wall structure Density: 0.15-0.22 g/cm ³ Deodorant content: 85-95 %	- Coated NCB powder onto the Nylon or polyester mesh - Polymer binder - Bendable mesh typed - Density: 0.41 ± 0.05(g/cm ³) - Deodorant content: 50-60%	- Coated NCB powder onto the polyester texture - Polymer binder - Bendable sheet typed - Density: 0.47 ± 0.05(g/cm ³) - Deodorant content: 60-70%	- Combination filter: Particle filter + deodorizer - Excellent performance for the elimination of VOC, NO _x , SO _x - Antifungal, Antibacterial activity	- Extrusion of deodorant Deodorant content: 90% - Cell number: 20-200 cpsl - Hardness : 5-10kg/cm ² - BET: over 500m ² /g - Minimize the pressure drop	- Coated NCB powder onto the polyurethane foam - Deodorant content: 50-60% - Controllable thickness - More upgraded deodorization activity



3. NCB, Synthesis & Products

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NCB Products

- Nano Carbon Ball, Nano Silica Ball
- Deodorizer for Refrigerator: Sheet, Mesh, Bead, Honeycomb
- Deodorization Filters for Air conditioner/Air cleaner: Mesh, Urethane foam
- Deodorization Filter for Vacuum Cleaner: Urethane foam
- Cabin Filter for Vehicle
- Consumer Products: Nano Power Deodorizer for refrigerator and vehicle
- NCB for Gas Mask



4. NCB, Applications for Well-Being

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4. Nano Carbon Ball, Applications for Well-Being



4. NCB, Applications for Well-Being

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Application for Well-Being

신체의 여유
건강
기어스케어
즐거움
.
.



QOL
Relax
Equilibrium
Fun
.
.

Fast Well-Being
-Quick Result
-Multi purpose



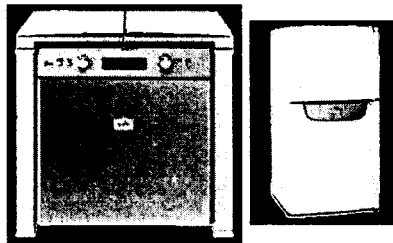
4. NCB, Applications for Well-Being

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Refrigerators

- LG DIOS
- Kimchi 冷蔵庫
- China Export Model





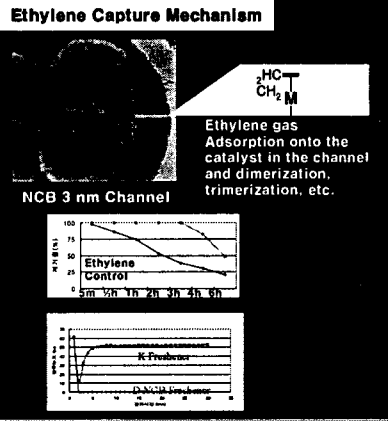
4. NCB, Applications for Well-Being

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Deodorization + Freshness Effect

$H_2C=CH_2$
Ethylene gas
(plant growth hormone)

- ▷ Accelerate ripening and softening of fruits
- ▷ Accelerate senescence and loss of green color in some immature fruits
- ▷ Accelerate decay and yellowing of fruits, vegetables and flowers.



	0 day	5 day	16 day
Commercial deodorizer			
NCB Deodorizer			

Colony	Microbial Colonies
Commercial Deodorizer (52 colonies)	
NCB Deodorizer (11 colonies)	



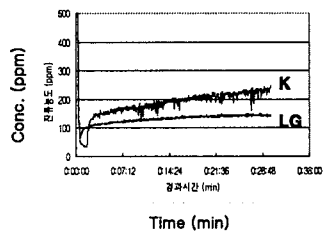
4. NCB, Applications for Well-Being

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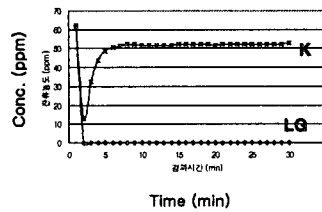
Deodorization + Freshness Effect

- NCB-P Catalytic System

Methyl mercaptan




Ethylene




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4. NCB, Applications for Well-Being



Air Conditioner
- LG Whisen
- LG Air conditioner
- ART COOL

Air Cleaner
- LG Clena



Vacuum Cleaner

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4. NCB, Applications for Well-Being

Excellant deodorization

Sample: NCB Mesh Filter for air conditioner and air cleaner
Test method: Chamber method (JEM 1467-1995)

Substance	Filter Type	Residual (%) at 0 min	Residual (%) at 10 min	Residual (%) at 20 min	Residual (%) at 30 min	Residual (%) at 40 min
Pyridine	NCB	100	~40	~20	~10	~5
	TiO ₂	100	~90	~85	~80	~75
Ammonia	NCB	100	~20	~10	~5	~2
	Non-NCB	100	~95	~90	~85	~80
Formaldehyde	NCB	100	~10	~5	~2	~1
	TiO ₂	100	~80	~75	~70	~65
Acetic acid	NCB	100	~10	~5	~2	~1
	TiO ₂	100	~70	~65	~60	~55
Trimethylamine	NCB	100	~20	~10	~5	~2
	Non-NCB	100	~80	~75	~70	~65
Acetaldehyde	NCB	100	~10	~5	~2	~1
	Non-NCB	100	~95	~90	~85	~80

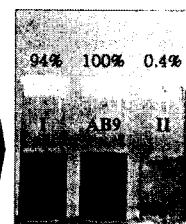
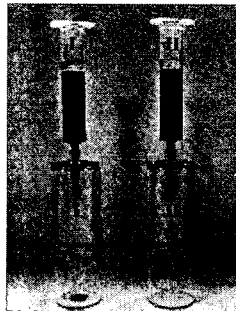
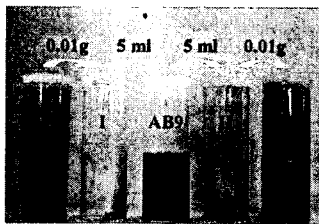
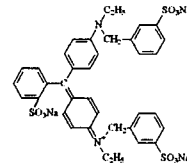


4. NCB, Applications for Well-Being

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Water Purification (Dye Adsorption)

Nano Carbon Ball (NCB) shows excellent Dye (Acid blue 9)-adsorption performance.
Activated carbon : NCB
(6% adsorption) (99.6% adsorption)



4. NCB, Applications for Well-Being

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Certificates of Nano Carbon Ball

Quality

- Q mark, quality assurance mark: QA 0149 (2003)
- S mark, safety mark: SA 110 (2003)
- Certified by "Korea Testing and Research Institute for Chemical Industry"



Safety


- LD₅₀: > 5,000 mg/kg
- Acute Toxic Class Method Classified into "Category 5" according to OECD Harmonized Integrated Classification System ENV/JM/MONO(2001)6 (14 August 2001)
- Certified by LG Life Sciences, Ltd., Toxicology center (Good Laboratory Practice, GLP, organization)



Approval


- KT mark (Excellent Korean Technology)
- Certified by Korea Industrial Technology Association



 **5. Conclusion**

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5. Conclusion

 **5. Conclusion**

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Conclusion

- 1. Understand the Nanotechnology**
- 2. Understand how people discover nanotechnology**
- 3. Nanotechnology leads to the synthesis of the unique deodorizer, Nano Carbon Ball.**
 - Nano Carbon Ball shows an excellent performance for the adsorption of malodors in the air and dyes in the water.**