Seminar of KOPAST

# Application of Nanotechnology to Packaging

Department of Packaging
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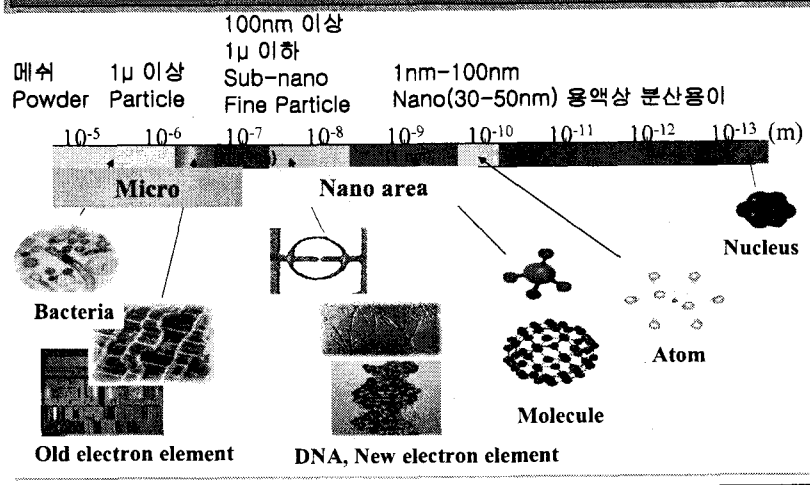
## Nano 입자



# 나노입자의 특성

1. **Effect of Surface Area**

| Particle size (nm) | Number of atom | Surface atom (%) |
|---|---|---|
| 10 | 30,000 | 20 |
| 5 | 4,000 | 40 |
| 2 | 250 | 80 |
| 1 | 30 | 99 |

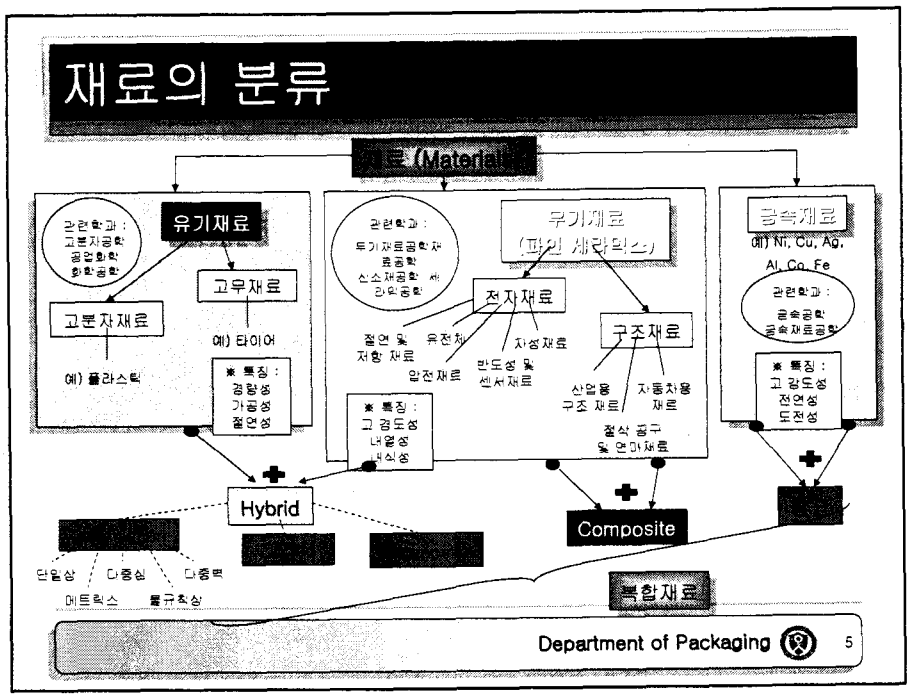
2. **Increase of Strength, Transparency, Elasticity**

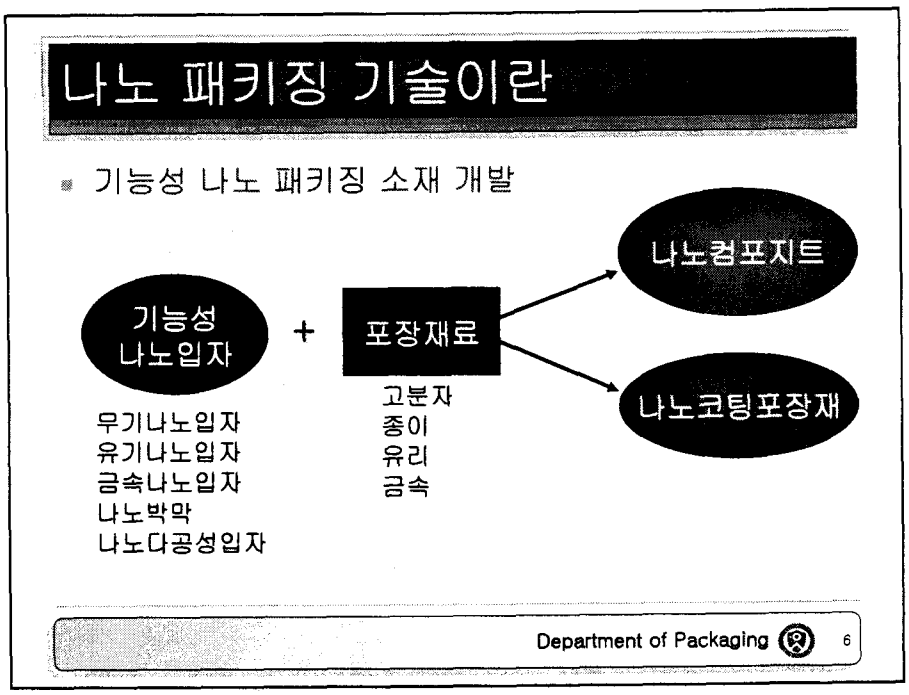
3. **Effect of Magnetic Properties**



# 나노소자의 특징

- 광학적 특성
  - 광학스펙트럼 blue-shift
  - 반도체 발광효율 증가
- 화학적 특성
  - 살균력, 자가세척력,
  - 냄새제거
- 기계적 특성
  - 경도 및 강도 증가
  - 연성, 인성, 가공성 증가
- 전기적 특성
  - 전기전도도 증가(세라믹)
  - 전기저항 증가(금속)
- 자기적 특성
  - 임계 크기까지의 보자력 증가
  - 임계크기 이하에서 보자력 감소로 인한 초상자성 거동


재료의 분류
료 (Material)
관련학과 :
고분자공학
공업화학
화학공학
유기재료
고무재료
고분자재료
예) 타이어
예) 플라스틱
* 특징 :
경량성
가공성
절연성
관련학과 :
무기재료공학자
료공학
신소재공학
무기재료
(파인 세라믹스)
전자재료
구조재료
절연 및
저항 재료
유전체
압전재료
자성재료
반도성 및
센서재료
산업용
구조 재료
자동차용
재료
절삭 공구
및 연마재료
* 특징 :
고 경도성
내열성
내식성
금속재료
예) Ni, Cu, Ag,
Al, Co, Fe
관련학과 :
금속공학
금속재료공학
* 특징 :
고 감도성
전연성
도전성
Hybrid
Composite
복합재료
단일상
다중심
다중벽
메트릭스
불규칙상
Department of Packaging
5


나노 패키징 기술이란
기능성 나노 패키징 소재 개발
기능성
나노입자
+
포장재료
나노컴포지트
나노코팅포장재
무기나노입자
유기나노입자
금속나노입자
나노박막
나노다공성입자
고분자
종이
유리
금속
Department of Packaging
6

# 나노입자 생성기술

*Bottom-up vs. Top-down*

Top-down manufacturing

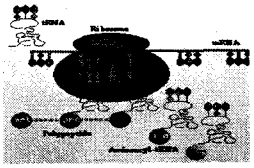
- Traditional approach
- Take away material until what is left is the product

Eg. Sculpting

Bottom-up manufacturing

- Nanotech approach
- Add material until the product has been created

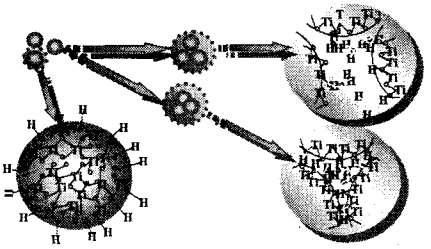
Eg. Biological systems

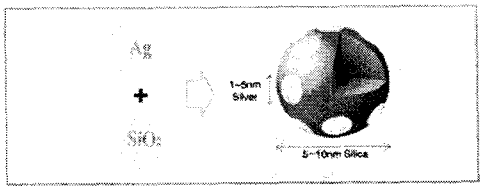




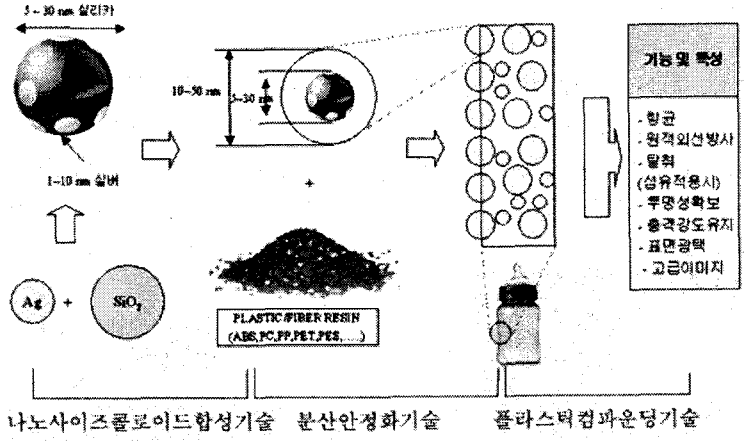
# 나노입자 생성기술

- 입자생성기술
  - 유기/무기/금속
- 입자크기조절기술
- 입자복합화기술
  - Dopping 기술
  - 캡슐기술
- 나노입자 모양조절 기술
- 입자증착기술
  - 금속입자증착
  - 무기입자증착



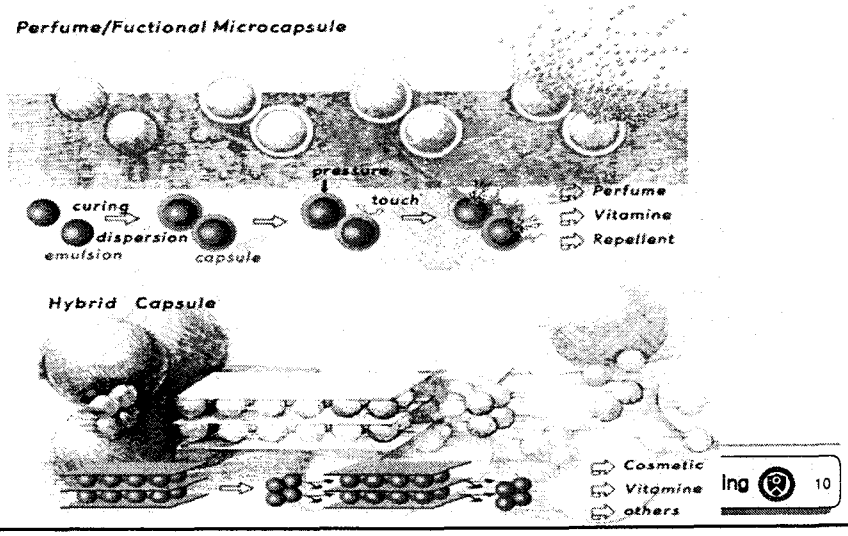


# 나노분산기술



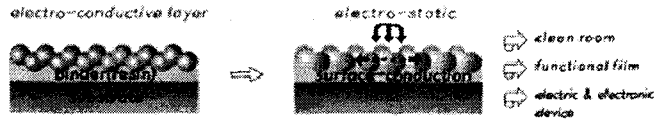



# 나노입자캡슐기술

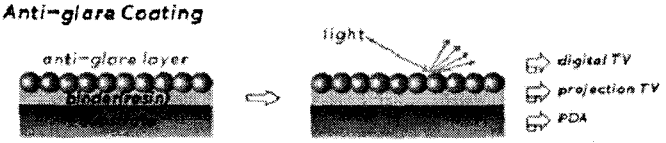


# 나노코팅기술

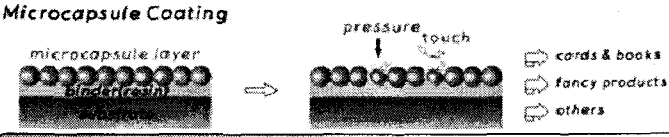
**Transparent Electro-Conductive Coating**




**Anti-glare Coating**

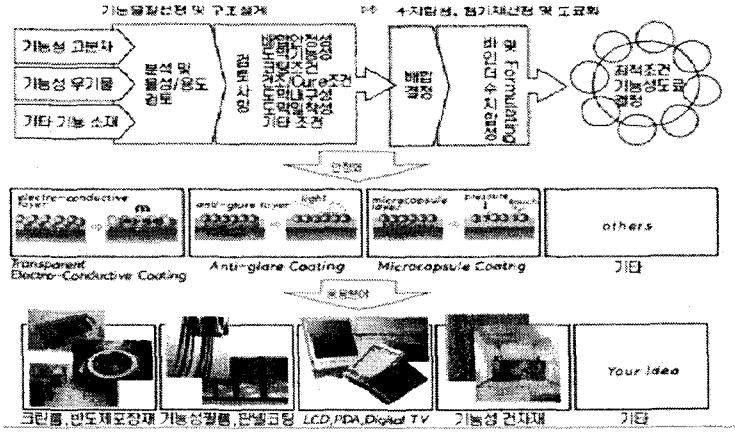



**Microcapsule Coating**






# 나노복합포장재료 합성기술



# 패키징의 나노기술의 용용사례

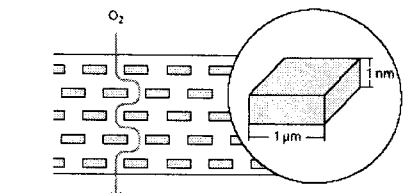
- Enhanced Properties
  - Improved mechanical or gas barrier properties
  - Better temperature or chemical resistance
  - Enhanced clarity and surface appearance
  - Better conductivity
- Protect packaged product Properties
  - Longer shelf life
  - Printable electronics
- Enhanced Functional Properties Thinner films
  - Anti-microbial
  - Sensory packaging
- Environmental Friendly Properties
  - Thinner Film
- Brand protection

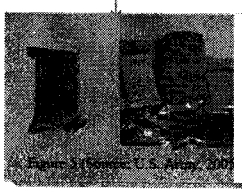


# Nanocomposite PKG applications

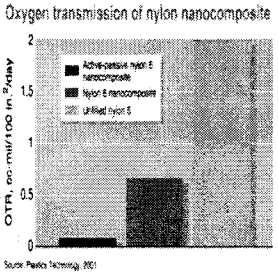
| Supplier | Matrix resin | Nano filler | Use |
|---|---|---|---|
| Bayer AG (Durethan LPDU) | Nylon-6 | Organoclay | Barrier film |
| Clairant | Polypropylene | Organoclay | Packaging |
| Nanocor (Imperm) | Nylon MDX6 | Organoclay | PET beer bottles |

*Source: Plastics Technology Online and Bins & Associates*



Oxygen transmission of nylon nanocomposite




# Nano-PKG Application

- Mechanical Properties Enhancement
- Printing
- Food application
- Micro-sensors



# Future Study for Nano-PKG

- Nanotechnology to enhance the properties of renewable packaging materials. Applications and research areas would include:
  - Nano reinforcement -using nanotech in fibre engineering to enhance the strength of board and thus reducing materials
  - Nanocoatings-to enhance barrier properties
  - Nanocomposites
  - Nano barcodes and taggants -for track and trace and brand protection of packaging
  - Nano technology in paper -like electronic displays-which can be used to display information to the retailer/consumer about the freshness or condition of the product.
  - Intelligent inks -nanotech-enabled oxygen indicators

## 나노포장기술에 관련된 산업

- Producers of packaging materials
  - paper, rigid and flexible plastics, labels, glass, metals, foils and composites
- Packaging manufacturers and converters across all materials and end uses
- Packaging and label printers
- Coatings, adhesives, inks and other packaging chemicals suppliers
- Package print equipment manufacturers
- Packaging machinery suppliers
- Packaging buyers from brand owners and supermarket retailers
- Suppliers of nano-materials
- Governments, research institutes, academics who are active in the field of nanotechnology



## 나노포장기술의 활성화의 장애

- 포장시장의 한계(가격)
- 연구개발비의 한계
- 연구인력의 한계
- 시장규모의 한계
- 새로운 해외시장 모색의 한계