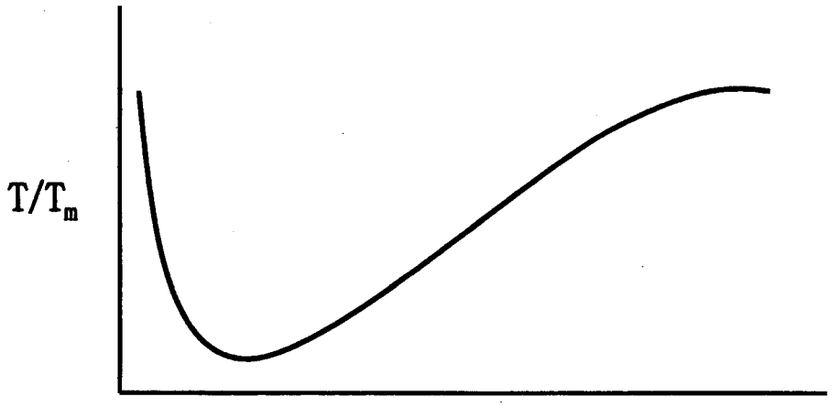
Introduction

나노입자에서 관찰된 새로운 물성변화

물성변화	재료	직경(Å)	Nanoparticles	Bulk
자기적성질향상	Fe	50	~1000e	~4700e
융점 강하	Au Sn	30 40		1300K 450K
광흡수증가 (6~10㎛)	Au	100		1~5%
초전도장어온도상승	Al	90		3.4K
극저온에서의 열전도성 향상	Ag	100		20nK
소결온도의 저하	Ni W	300 220		700℃ 예상 2000℃ 이상
촉매효과의 증대 (As ; 표준활성도)	Au	10		~0.5

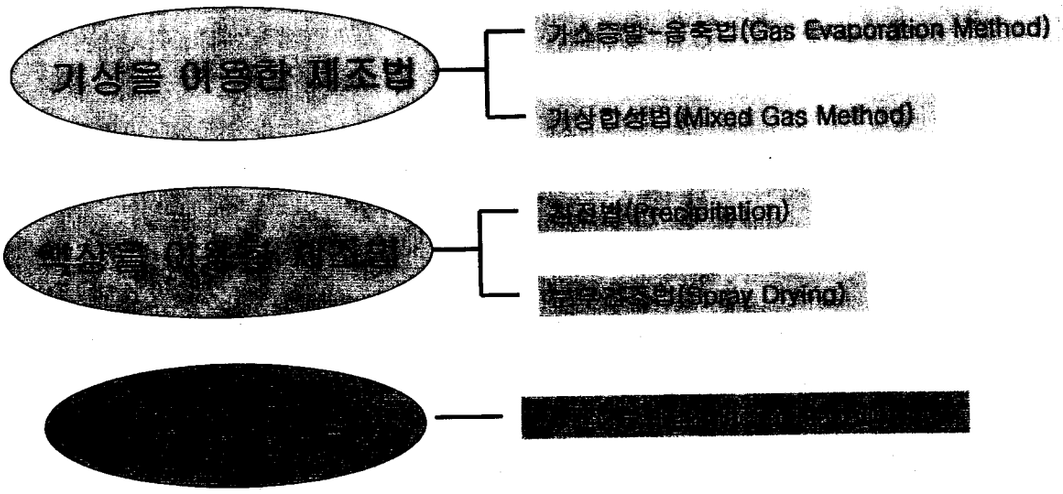
Nanoparticles Melting Point



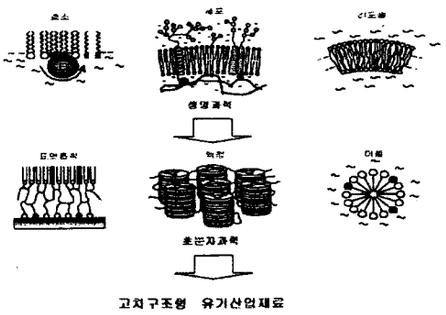
Applications of Nanosized Particles

특 성	용 도	재 료
전기 특성	○도전재료(도전페이스트, 전극재료) ○센서재료(가스, 습도, 온도등) ○초전도체 ○기타	SnO_2, In_2O_3, Ag, Carbon, Al_2O_3/SnO_2, TiO_2, YBaCuO
광학 특성	○광흡수체 ○광필터 ○광촉매 ○적외선센서 ○광도전체 ○광섬유 ○기타(감광제)	TiO_2, Fe-산화물, Au, SiO_2
열적 특성	○저온소결체(금속소결체, 세라믹소결체등) ○열교환체 ○내열재료 ○기타	SiC, Si_3N_4, YSZ
표시·기억특성	○표시장치(전계발광, 액정 등) ○기타	Ti-산화물
역학 특성	○내마모재료 ○연마재 ○공구소재 ○입자분산 고강도소재	SiO_2, Al_2O_3, WC, TiC, BN, Y_2O_3
자기 특성	○자기 기록재료(자기 테이프, 자기헤드 등) ○자성유체 ○영구자석 ○기타	Fe계 자성분말
화학 특성	○촉매 ○기타	Pt, Pd계
흡착 특성	○기체분리용 필터 ○집지기 ○열교환기 ○기체저장	Ni, Cu
연소 특성	○로켓트 고체 연료 ○액체연료 ○기타	
기타	○액체금속 ○흡음체 ○필터 ○밧데리전극 ○기타	Al_2O_3, Ta, MnO_2

미세입자의 제조법

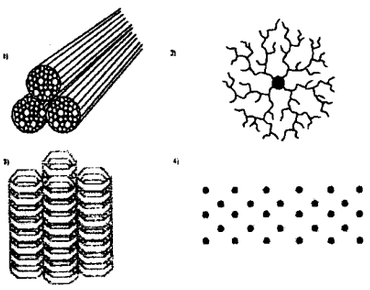


고차구조형 유기재료



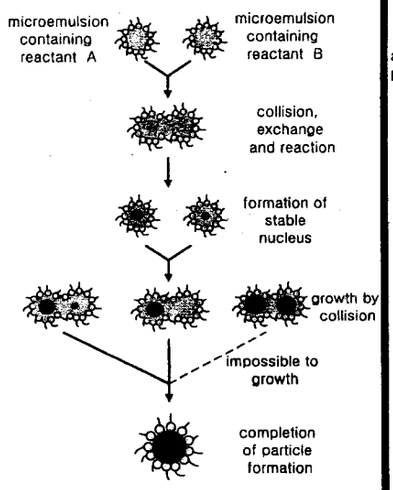
고차구조형 유기산업재료

1) Mesoporous **2) Dendrimer**
3) Nanotube **4) Nanocomposite**

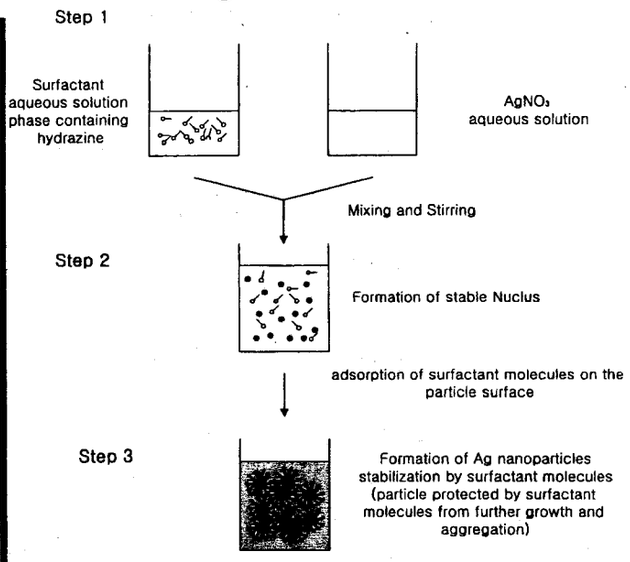


Experimentals

Reaction Diagram



Formation of ultrafine particles in microemulsions.



Metal particles by adsorption of surfactant on the surface of particles

Self-Assembling Molecules & Nanoparticles Lab.

Materials

Surfactants

Tween20(polyoxyethylene (20) sorbitan monolaurate, Aldrich) - 0.01M
SDS (sodium dodecyl sulfate, Aldrich 99.5%) – 0.01M
NP9(poly-oxyethlene (9) nonyl phenol ether, Ilchil Chemicals)-0.01M
CTAB(cethyl trimethyl ammonium bromide, Acros, Aldrich 99%)-0.01M

$AgNO_3$(silver nitrate, Aldrich, 99.995%) - 0.05M

Hydrazine Monohydrate(Aldrich, Assay 98%) - 0.1M

$$N_2H_4 + 4Ag^+ + 4OH^- \rightarrow 4Ag^0 + 4H_2O + N_2$$

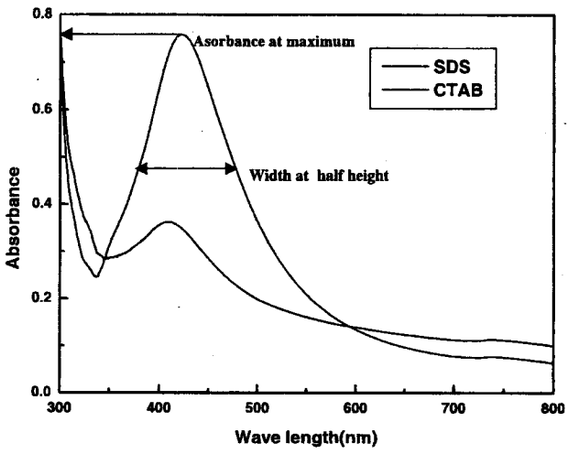
Reducing agent

- Ethylene glycol(J. Mater. Chem. 6(4), 573(1996)
- Ethylene oxide group(Langmuir, 12, 3585(1996)
- **Hydrazine(Langmuir, 15, 3050(1999)**
- Sodium borohydride (J. dispersion Sci. and Tech. 20(6), 1569(1999))

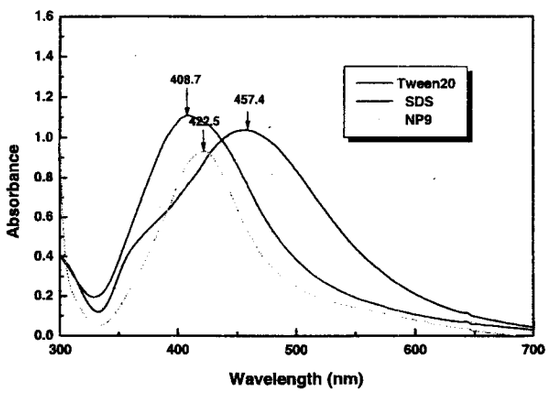
Instrumentation

- UV-visible and fluorescence measurement
  (Shimazu UV-2101PC)
- Dynamic light scattering
  (Malvern Zatamater Inc. – Wavelength 514.5nm of Ar-Ne)

Absorption spectra of silver plasmon resonance



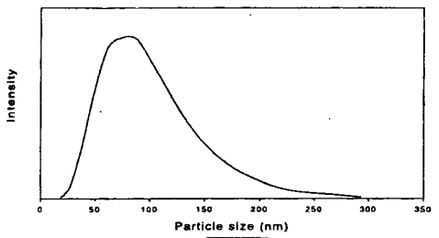
Silver plasmon band in the aqueous surfactant solution



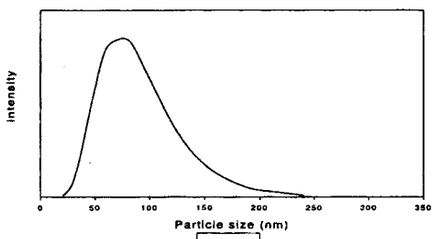
	UV –vis. absorbance	Particle Size	Stability
Aqueous Phase	-	-	Unstable
Tween20	408.7 nm	73.2 nm	30days
SDS	457.4nm	85.3nm	30days
NP9	422.5 nm	114.3 nm	<1day
CTAB	407.5 nm	5.21 ㎛	<1day

UV-vis. absorbance of silver particles prepared in presence of various surfactants as stabilizers (about 3hours after from reduction)

Particle size distribution

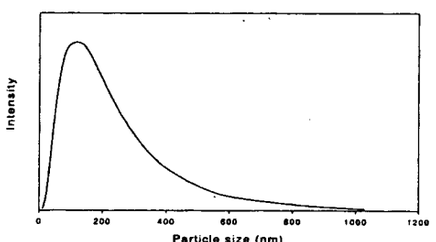


(a)

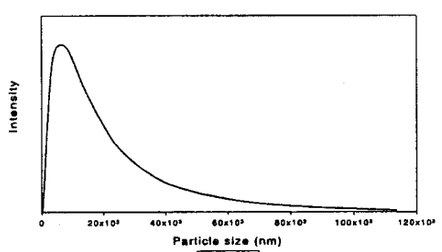


(b)

Particle size distributions of silver particles prepared in various surfactants as stabilizers
(a) SDS (b) Tween20



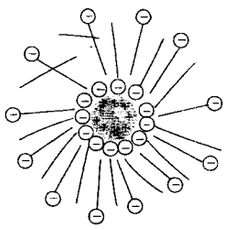
(c)



(d)

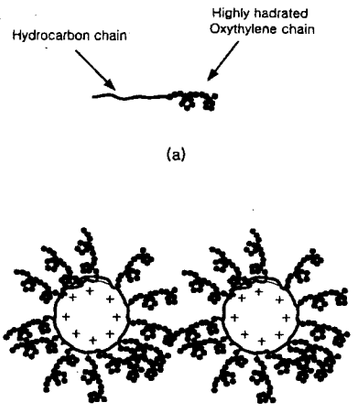
(c) NP9 (d) CTAB

Stabilization model for silver colloid



Adsorption of aninonic surfactant
on the particle surface

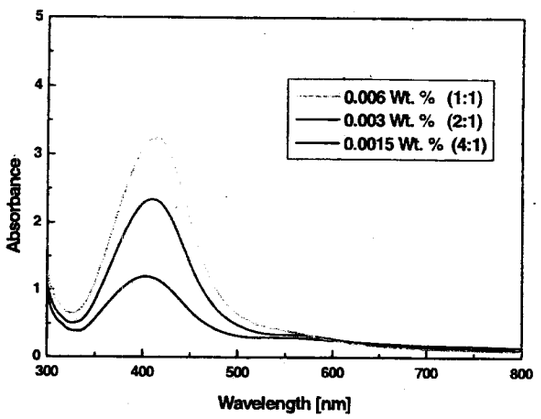
(SDS)



Particle stabilization mechanism by steric hindrance of surfactant
with hydrated polyoxyethylene in aqueous solution

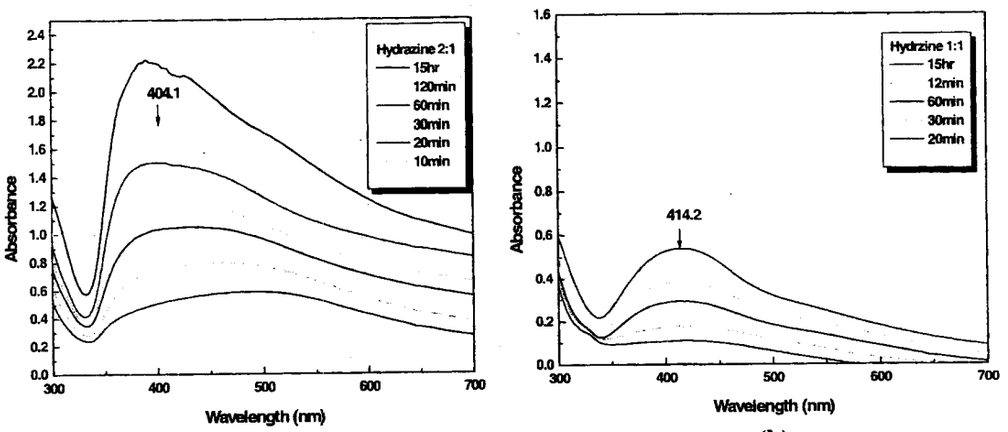
(Tween20)

Absoption spectra showing different $AgNO_3$ conc.



Preparation of Ag particles
in tween 20 (0.01M) aqueous solution

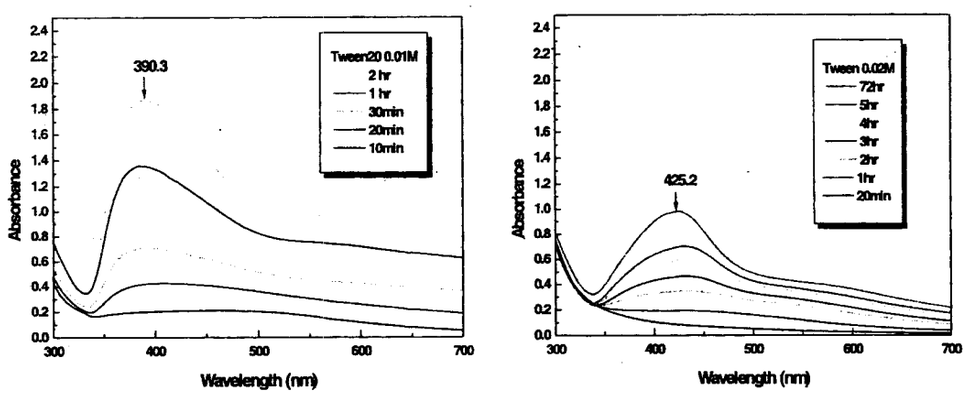
Absoption spectra showing different reductant Conc.



(a) (b)

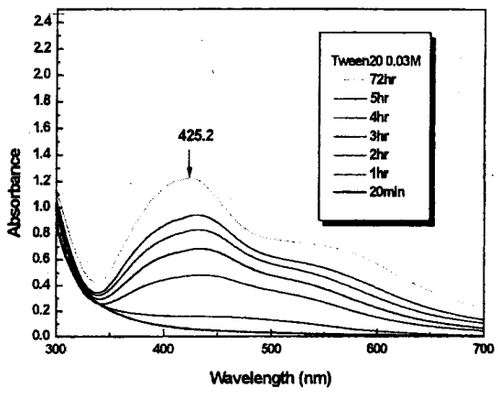
Different mole ratio of Silver(0.006 Wt %) and Hydrazine in tween 20 (0.01M) aqueous solution
(a) 2:1 (b) 1:1

Absoption spectra showing different Tween20 conc.



(a) (b)

Mole ratio of Silver(0.005 Wt %) and Hydrazine was 1:2 in Tween20 aqueous solution.
(a) Tween20 0.01M (b) Tween20 0.02M



(c)

(c) Tween20 0.03M

Summary

Stabilization Effect

SDS – Elcetrical repulsion caused by hydrophobic bonding.

Tween20 – Steric hindrance effect cause by highly hydrated polyoxyethylene groups

(NP9 - Not enough quantity of polyoxyethylene groups)

Particle size distribution

Tween20 > SDS > NP9 > CTAB

Surfactant effects

1. Acts as particle stablizer
2. Dissolves away the Ag ion from the particle surface to the bulk
3. Retards the rate of particle formation from Ag ion

Reductant effects

1. Act as reducing agent for Ag ion
2. Increases the reactivity of silver particle toward oxidation by oxygen

앞으로의 연구방향

- **Morphology of metal particles in surfactants aqueous solution.**
- **Synthesis of composite metal colloid.**
- **Metal Surface Modification.**