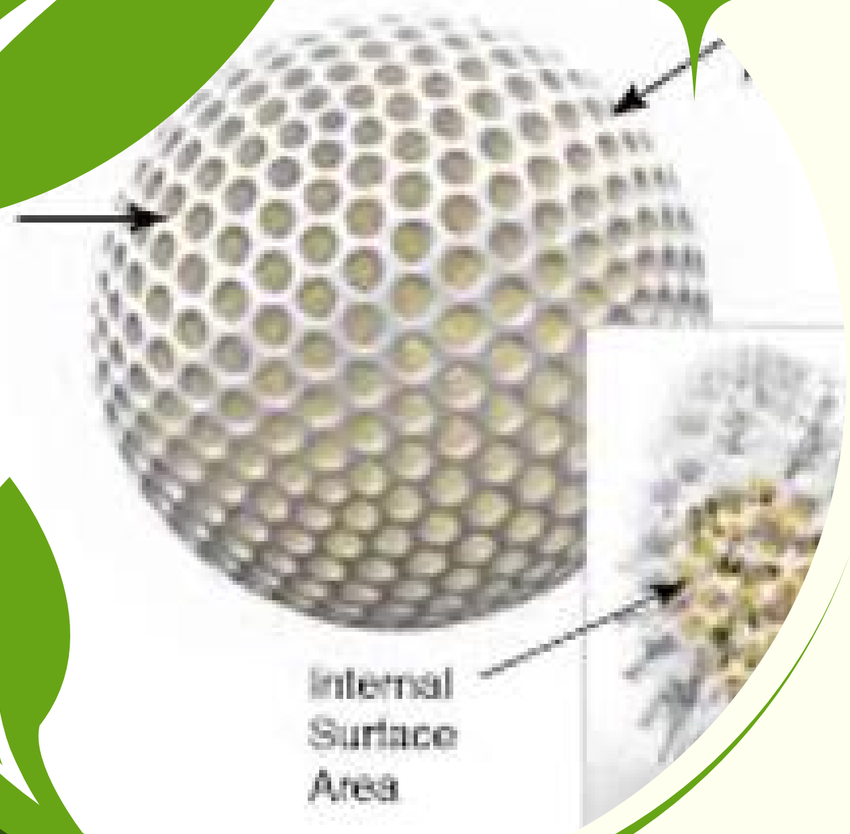
Hanover and Tyke



SINTESIS SILICA NANOPARTICLES

FOR BIOMEDICAL APPLICATION

Dr. Ir.Aniek Sri Handayani, MT, IPM

01

INTRODUCTION

Cangkang Sawit

Boiler

Abu Boiler

Abu Boiler diambil dari limbah Boiler Industri Kelapa Sawit

04

SIRCULER ECONOMY LIMBAH PABRIK KELAPA SAWIT

45,12 Juta ton
Produksi sawit Indonesia (2022)

9,376 Juta Ton
Limbah cangkang sawit dan Fiber (2022)

Pemanfaatan limbah cangkang sebagai BB Boiler, menghasilkan Abu Boiler 3,9%

Abu boiler menyebabkan masalah lingkungan

60-89,91% Silika dalam Abu Boiler Cangkang Sawit

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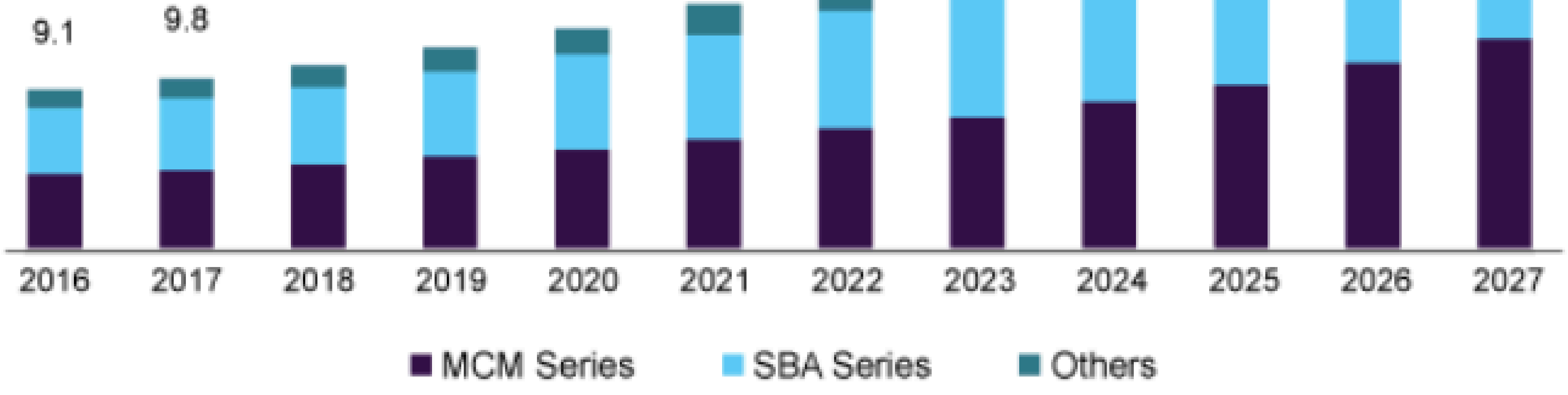
Total Permintaan Pasar (TAM) | Pasar Tersedia yang Dapat Dilayani | Pasar Terjangkau yang Dapat Dilayani

Impcbm Obslfutj{f wbmvf 4242	V%F 3732 n jmmjpo
Obslfu Wpmvn f 4242	3.9939 lh
Obslfu I spx ui	; 98&
T fwfovf Hpsfdbtu 4249	V%F 4;703 n jmmjpo
Wpmvn f Hpsfdbtu 4249	6 3370 lh

N_q_pQggi_ k cqmnmpsq bgA fgl_ 0. /4+0. 05 &SQB K gjjml '



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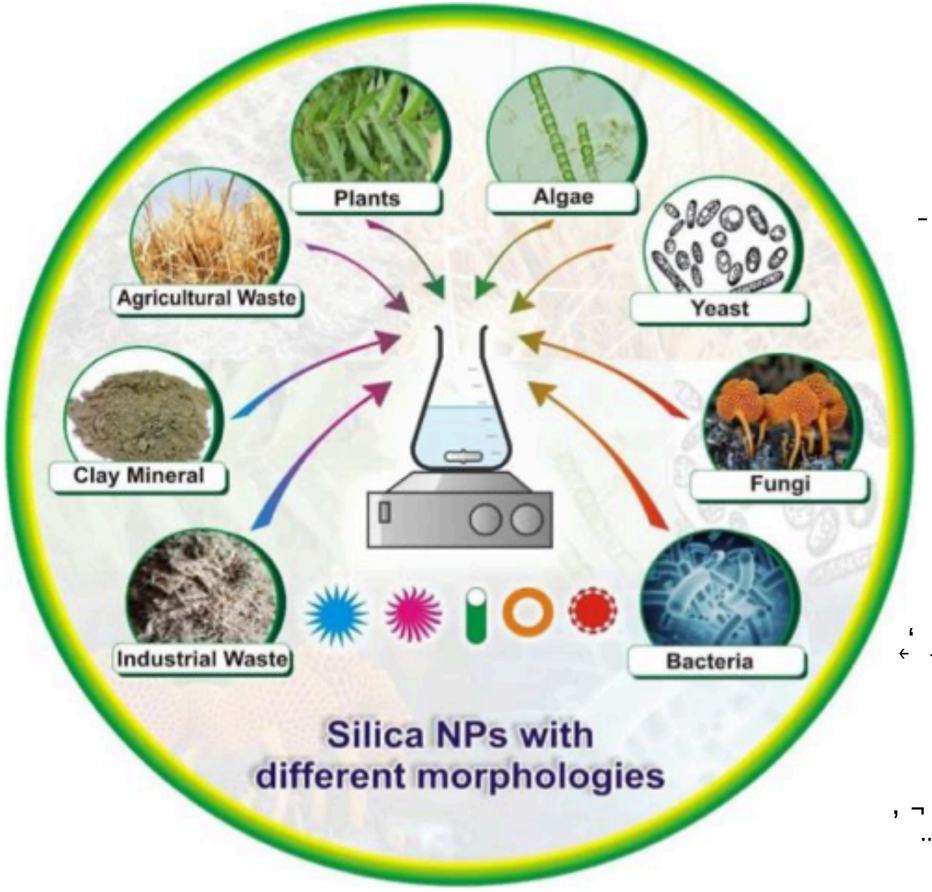
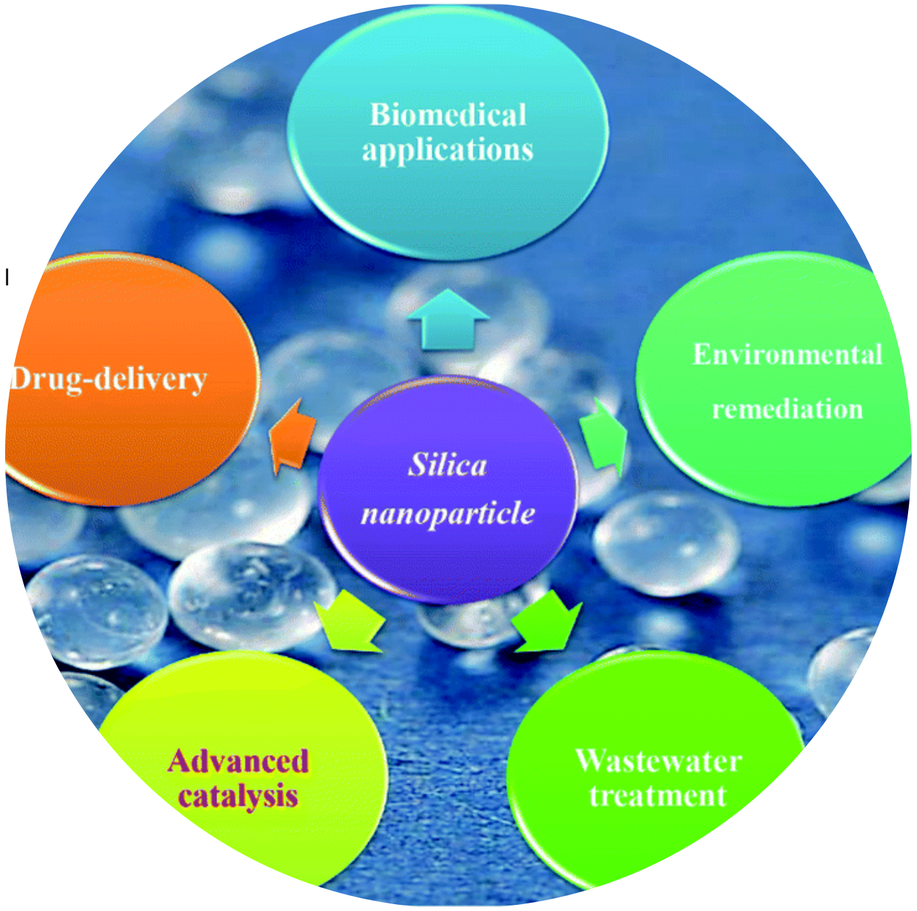
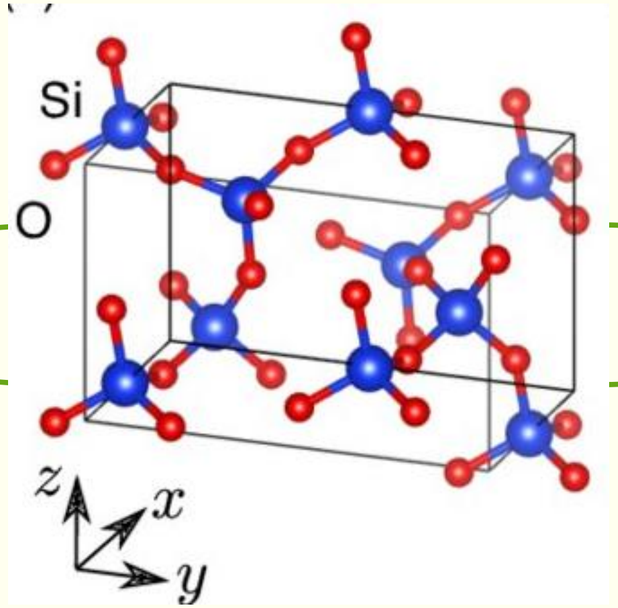

Plants
Algae
Agricultural Waste
Yeast
Clay Mineral
Fungi
Industrial Waste
Bacteria
Silica NPs with
different morphologies

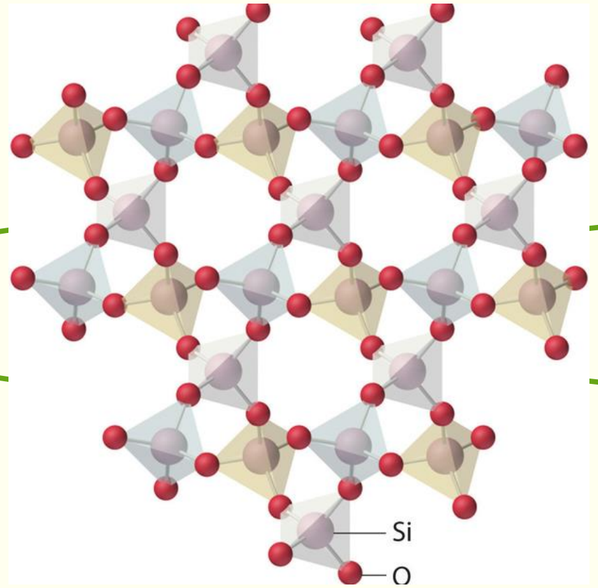

Biomedical applications
Drug-delivery
Environmental remediation
Silica nanoparticle
Advanced catalysis
Wastewater treatment

03

STRUCTURE OF SIO2



Crystalin Silica (doi: arXiv:1810.06500v1)



Silica Amorphous (https://chem.libretexts.org)

Crystalin Silica dikenal dengan SiO2. Struktur Silika dan struktur logam silikat hanya memiliki rumus molekul SiO4 Tetrahidral dan rasio SiO2 1:2 yang bersama sama digunakan untuk O2 pada tetrahidral dari silika.

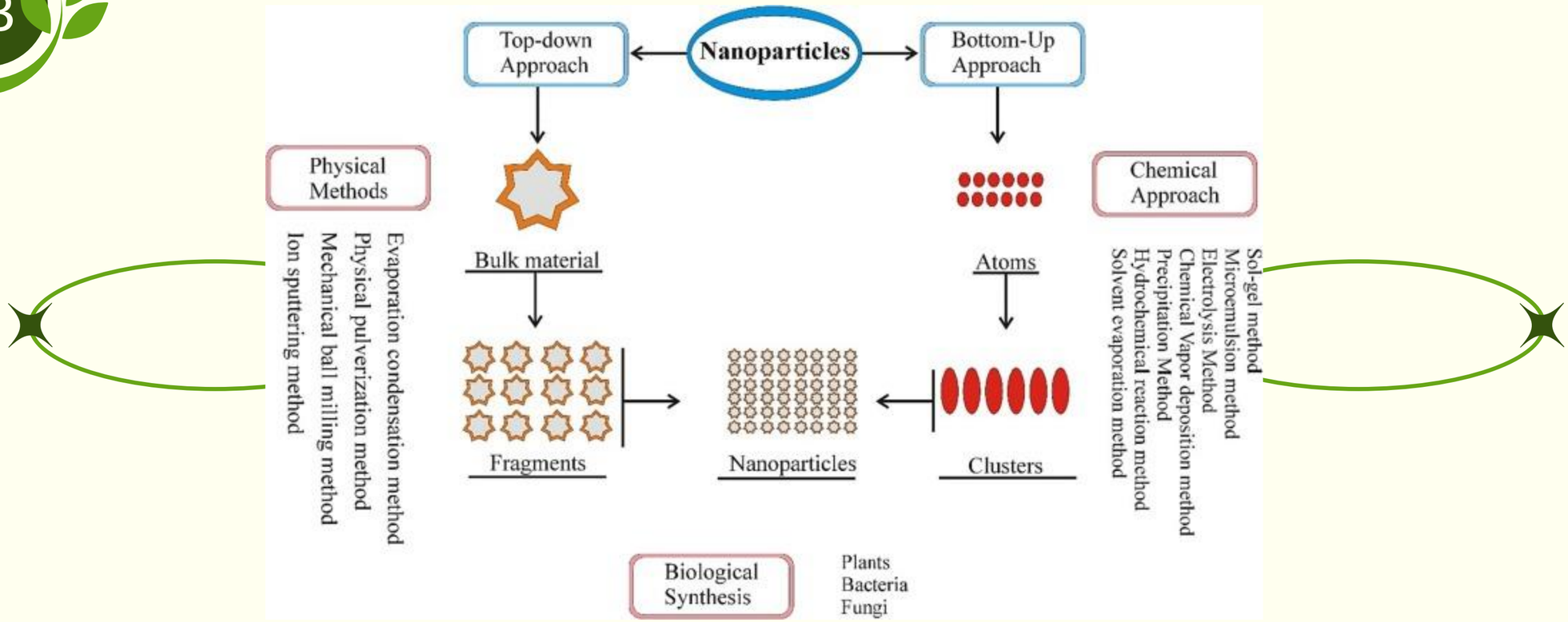
Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nunc ac auctor lorem, maximus scelerisque nibh. Suspendisse vel viverra lectus. Nam eu tortor sed sem tempus blandit ac a sapien. Donec pretium congue posuere.

870 C 1470 C 1710 C

Quartz → Tridymite → Cristobalite → melting point

03

HOW TO SYNTHESIS OF SILICA NANOPARTICLE



Physical Method

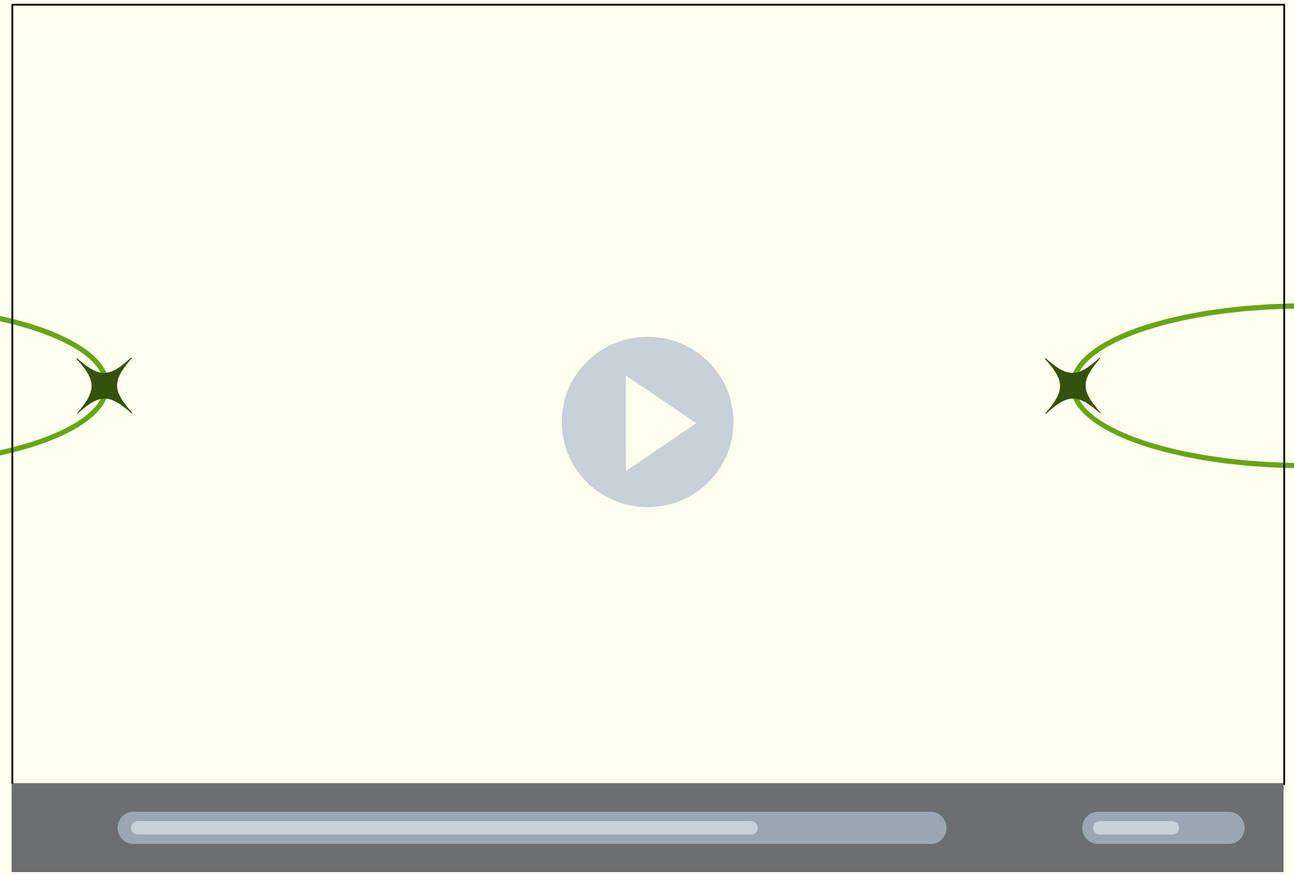
- Evaporation Condentation Method
- Physical Pulverization Method
- Mechanical Ball mill Method
- Ion Spultering Method

Chemical Approach

- Sol-gel Method
- Microemulsion Method
- Electrolysis Method
- Chemical Vapor Deposition Method
- Precipitation Method
- Hydrochemical Reaction Method
- Solvent Evaporation Method

03

SOL- GEL METHOD



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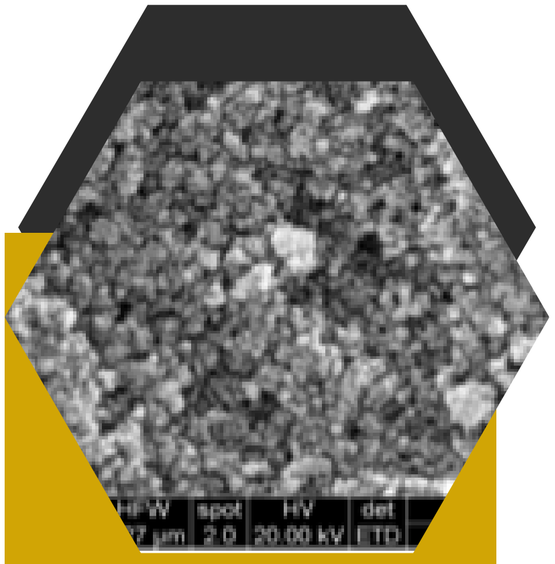
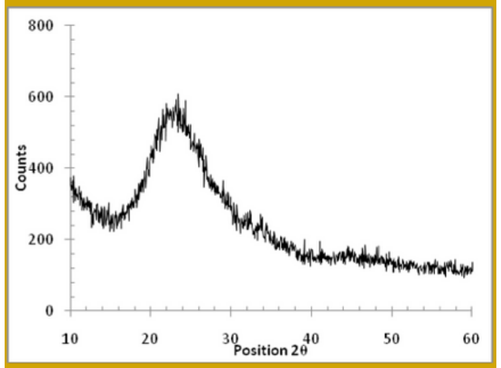
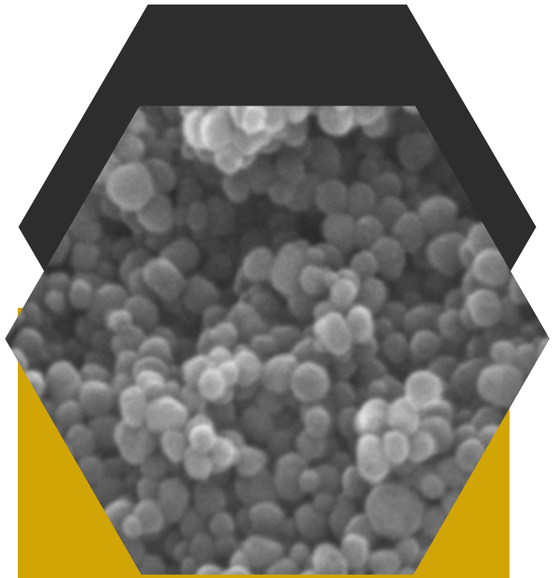
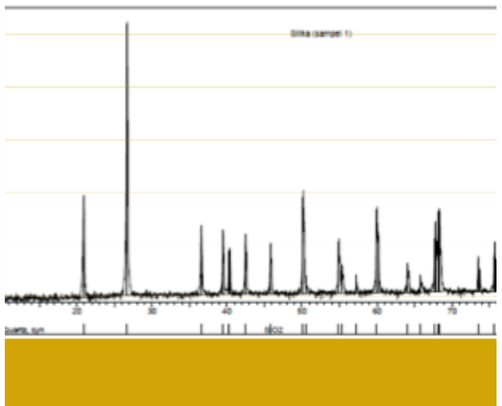
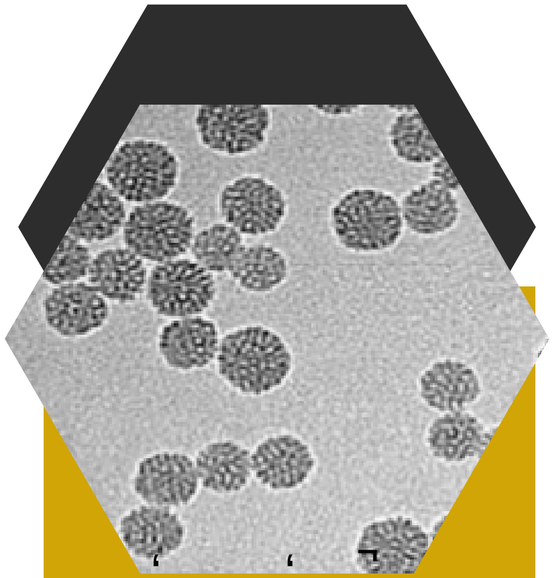
https://royalsocietypublishing.org/ on 06 February 2023

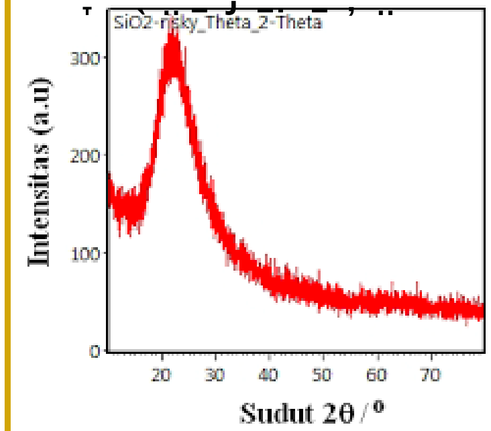












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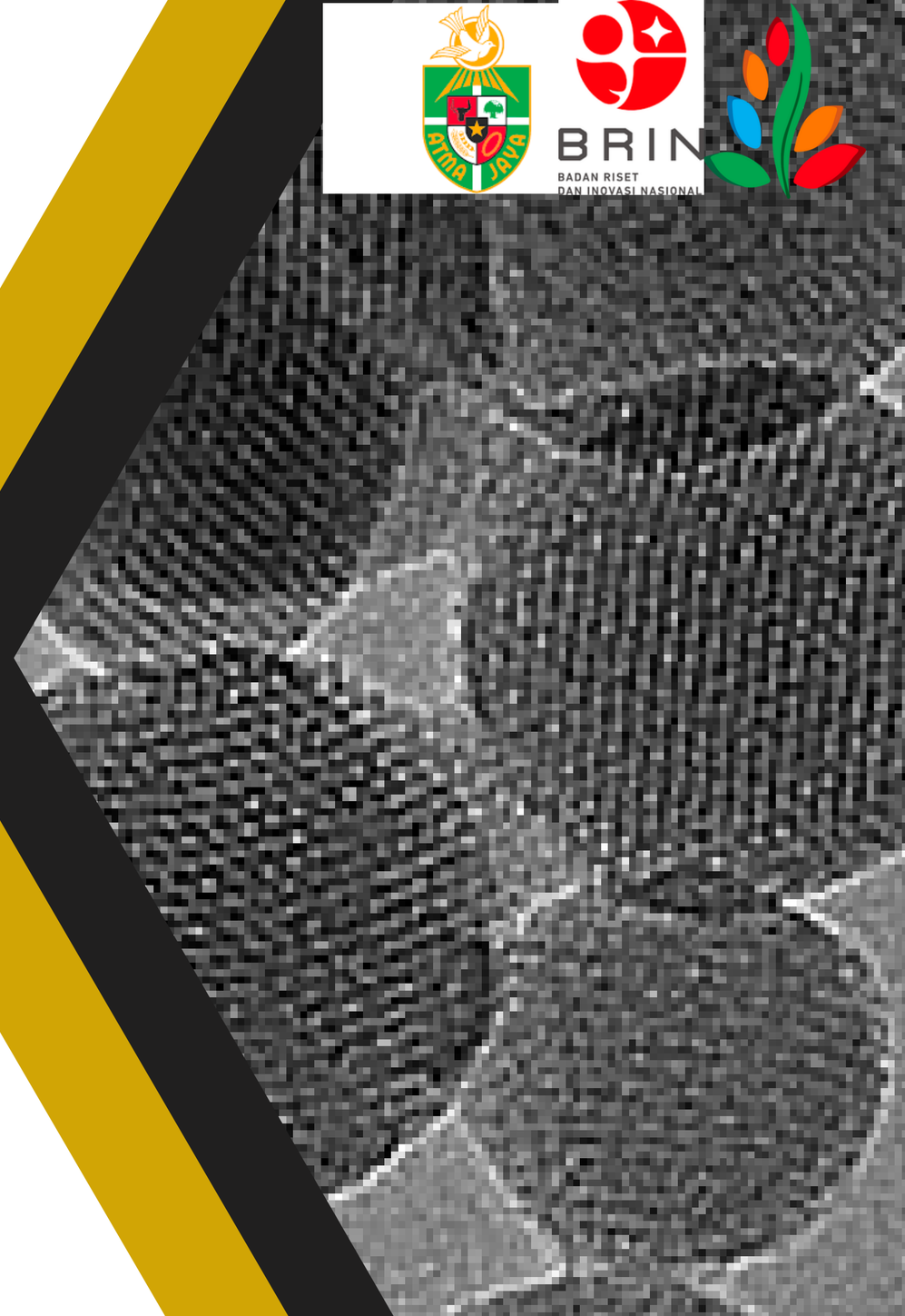


Jenis Mesoporous Sili a Nanoparti el

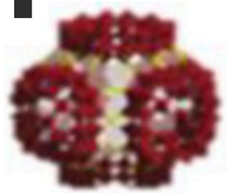
mesoporous silica materials yang diguna an untu drug delivery dan sifatnya. MCM, mobile crystalline materials SBA, Santa Barbara amorphous.

MSN family	MSN type	Pore symmetry	Pore size (nm)	Pore volume ($cm^3\ g^{-1}$)	References
M41S	MCM-41	2D hexagonal P6 mm	1.5–8	>10	[41]
	MCM-48	3D cubic Ia3d	2–5	>10	[45]
	MCM-50	lamellar p2	2–5	>10	[46,52]
SBA	SBA-11	3D cubic Pm3 m	2.1–3.6	0.68	[53]
	SBA-12	3D hexagonal $P6_3/mmc$	3.1	0.83	[52]
	SBA-15	2D hexagonal p6 mm	6–0	1.17	[54]
	SBA-16	cubic Im3 m	5–15	0.91	[55]

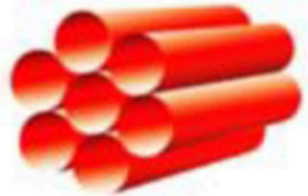

MCM-41


MCM-48

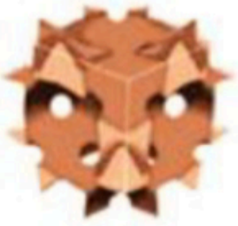

MCM-50


SBA-11


SBA-12

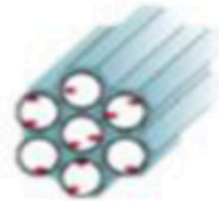

SBA-15

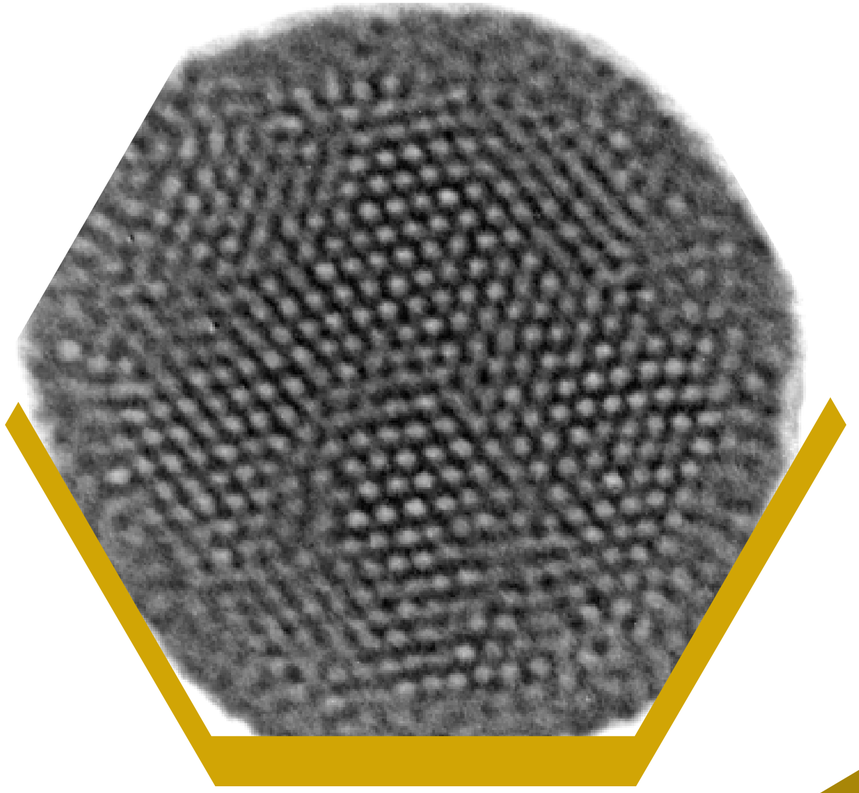

SBA-16

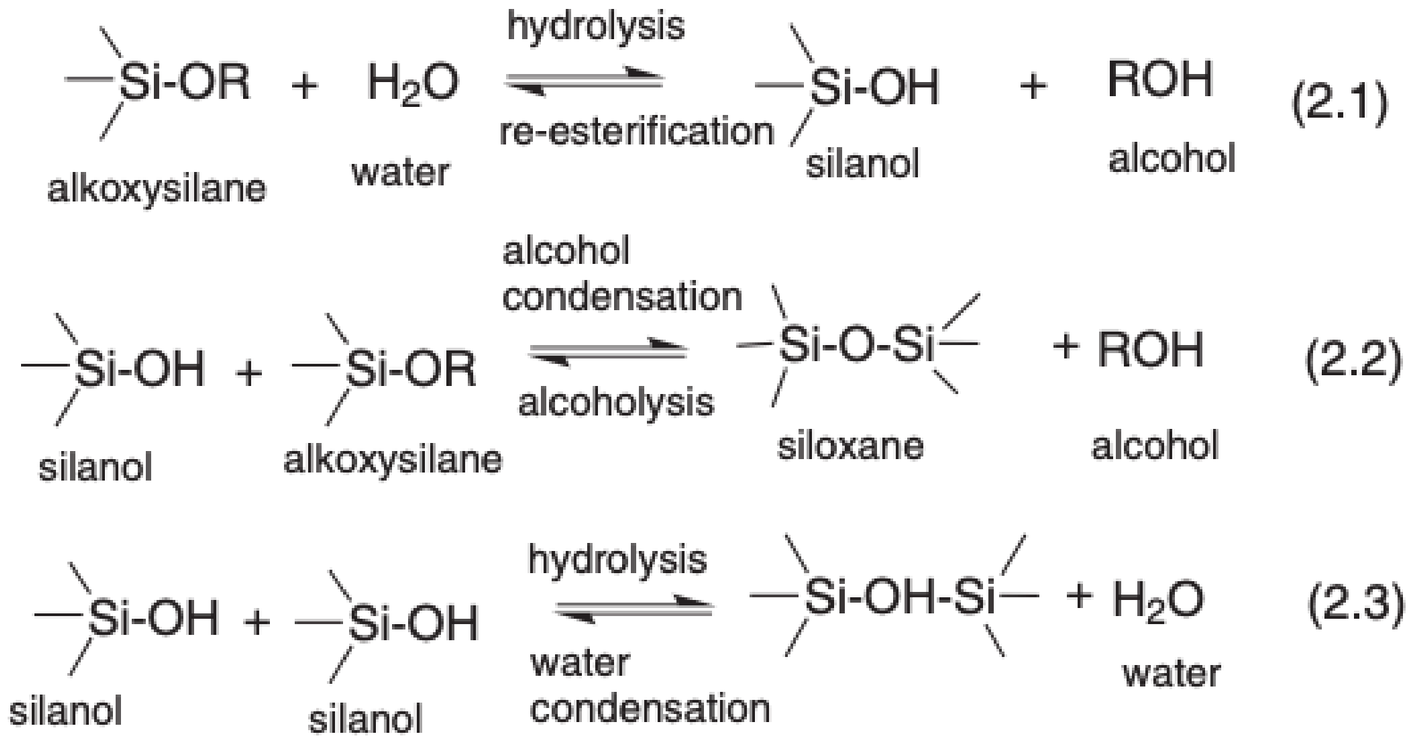

KIT-5


KIT-6

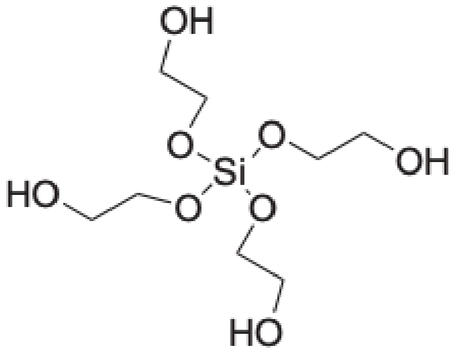

FDU-2


COK-12

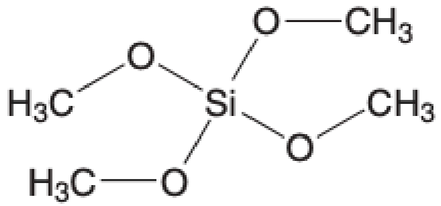



hydrolysis
Si-OR + H2O
re-esterification
Si-OH + ROH
alkoxysilane
water
silanol
alcohol
(2.1)
alcohol
condensation
Si-OH + Si-OR
alcoholysis
Si-O-Si + ROH
silanol
alkoxysilane
siloxane
alcohol
(2.2)
hydrolysis
Si-OH + Si-OH
water
condensation
Si-OH-Si + H2O
silanol
silanol
water
(2.3)

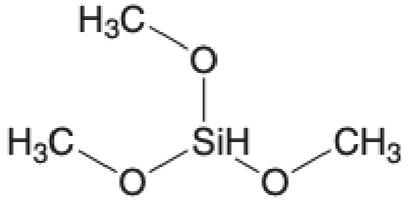
B **B** **B**



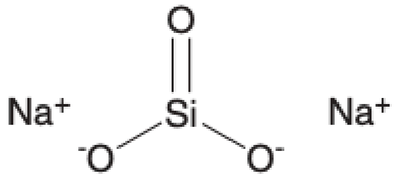
tetrakis(2-hydroxyethyl) orthosilicate
THEOS



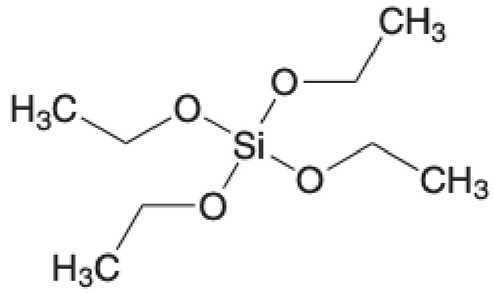
tetramethyl orthosilicate
TMOS



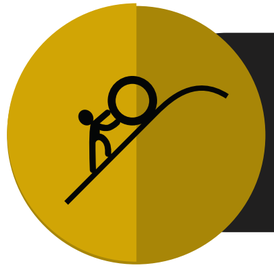
trimethoxysilane
(TMS)

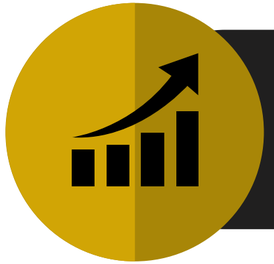


sodium metasilicate



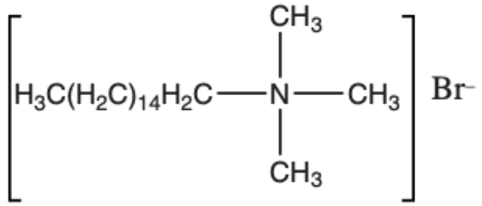
tetraethyl orthosilicate
TEOS



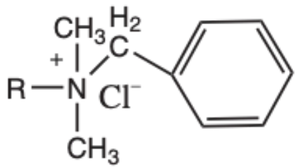


Struktur Kimia Surfaktan

(*a*) cationic surfactants

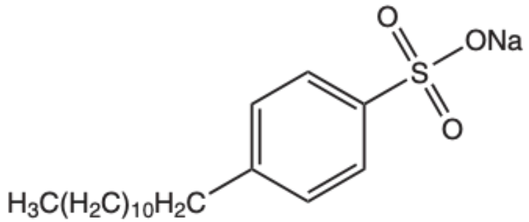


cetyltrimethyl ammonium bromide (CTAB)

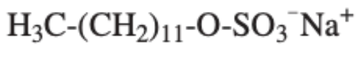


benzalkonium chloride (BAC)

(*b*) anionic surfactants

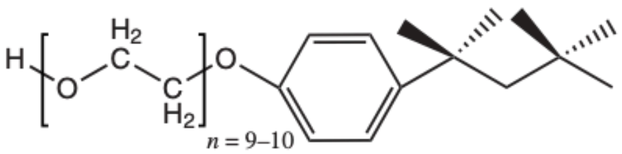


sodium dodecyl benzene sulfonate (SDBS)



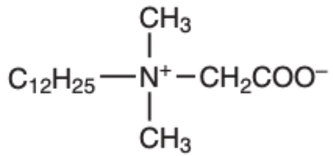
sodium dodecyl sulfate (SDS)

(*c*) non-ionic surfactants



Triton X–100

(*d*) amphoteric/zwitterionic surfactants



dodecyl dimethyl betaine

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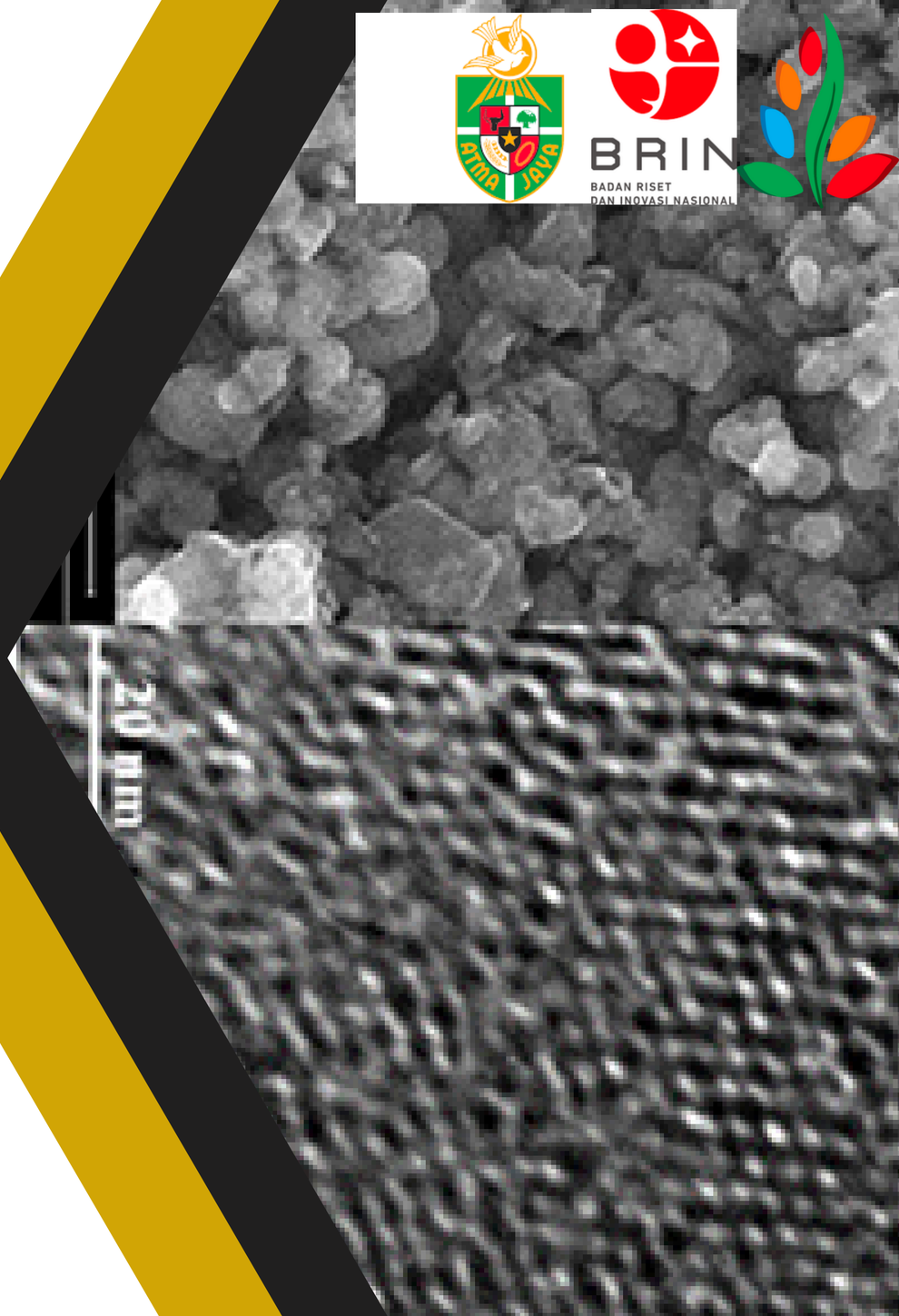

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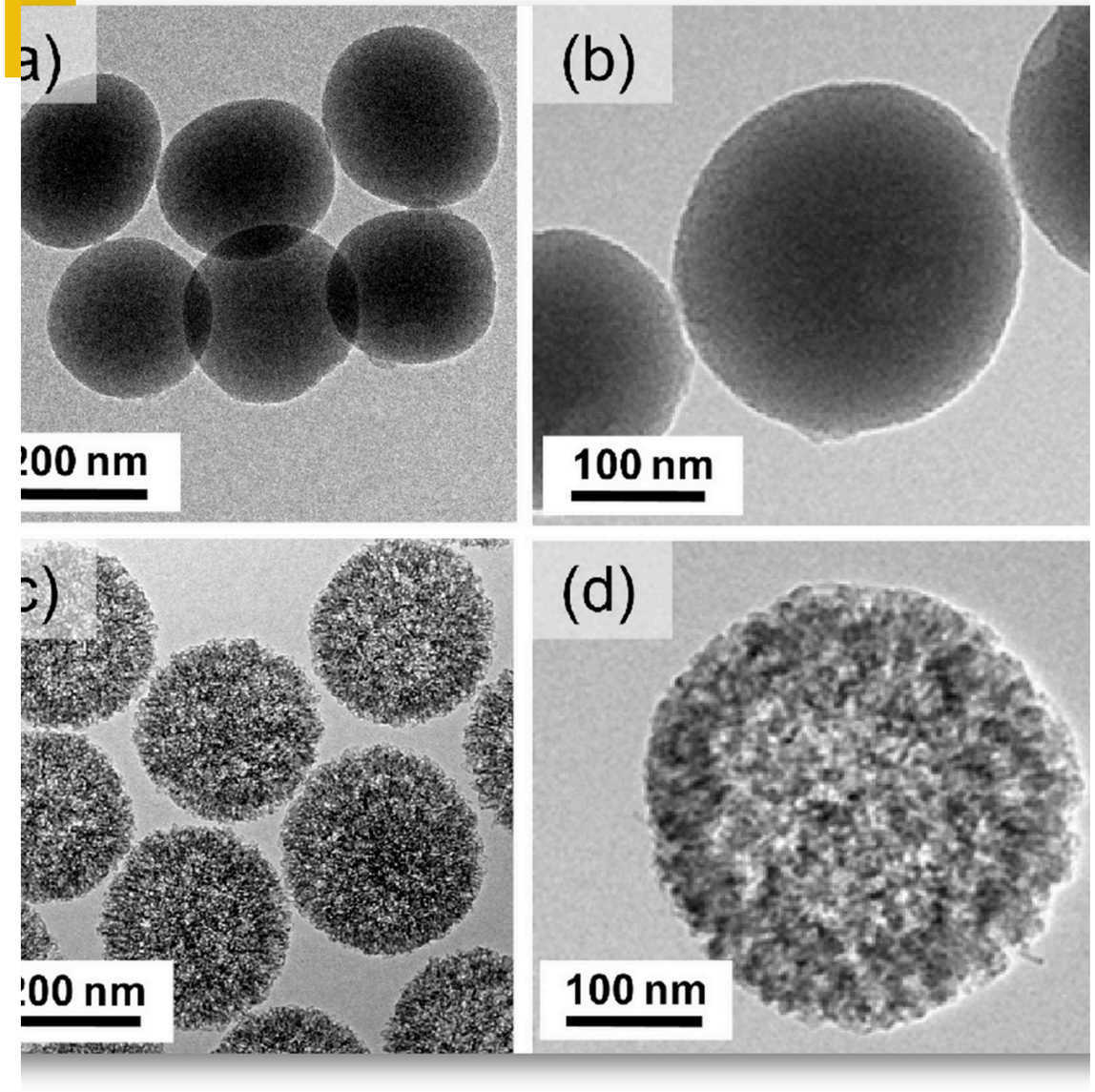
B B



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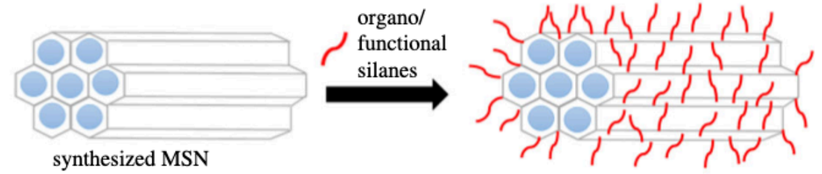
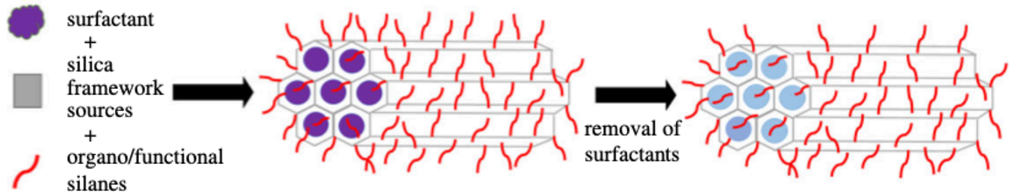
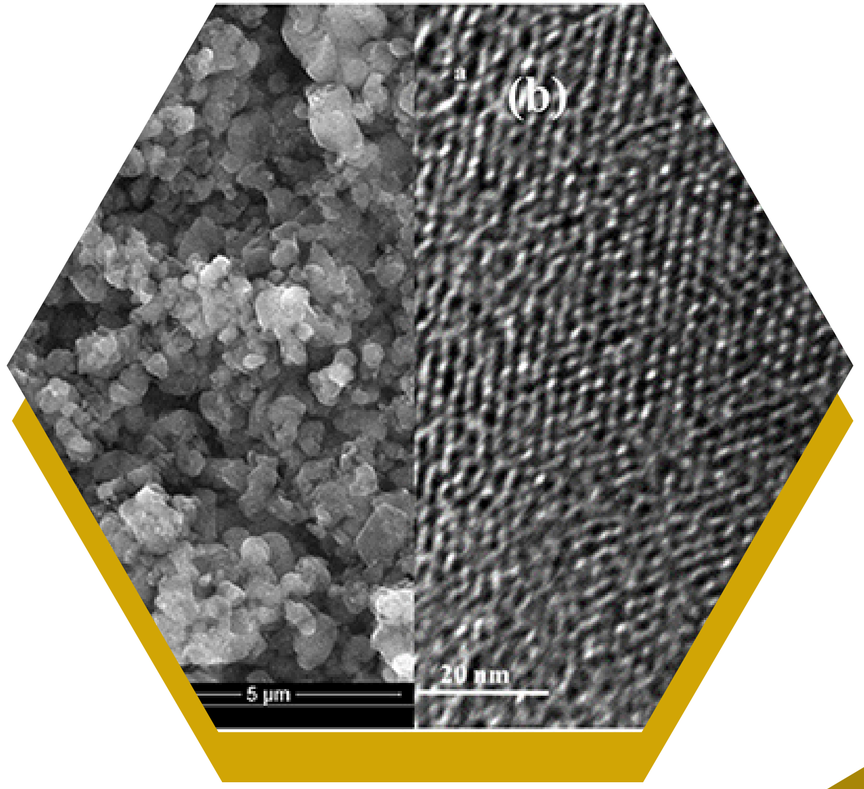
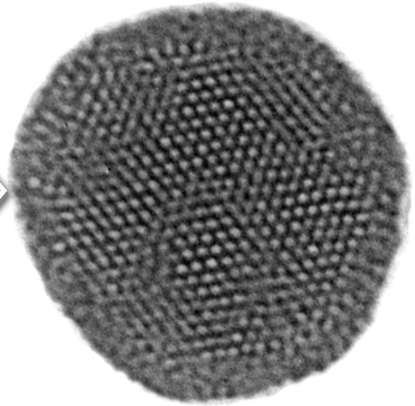
post synthesis or grafting method



co-condensation method




(b)
5 µm
20 µm



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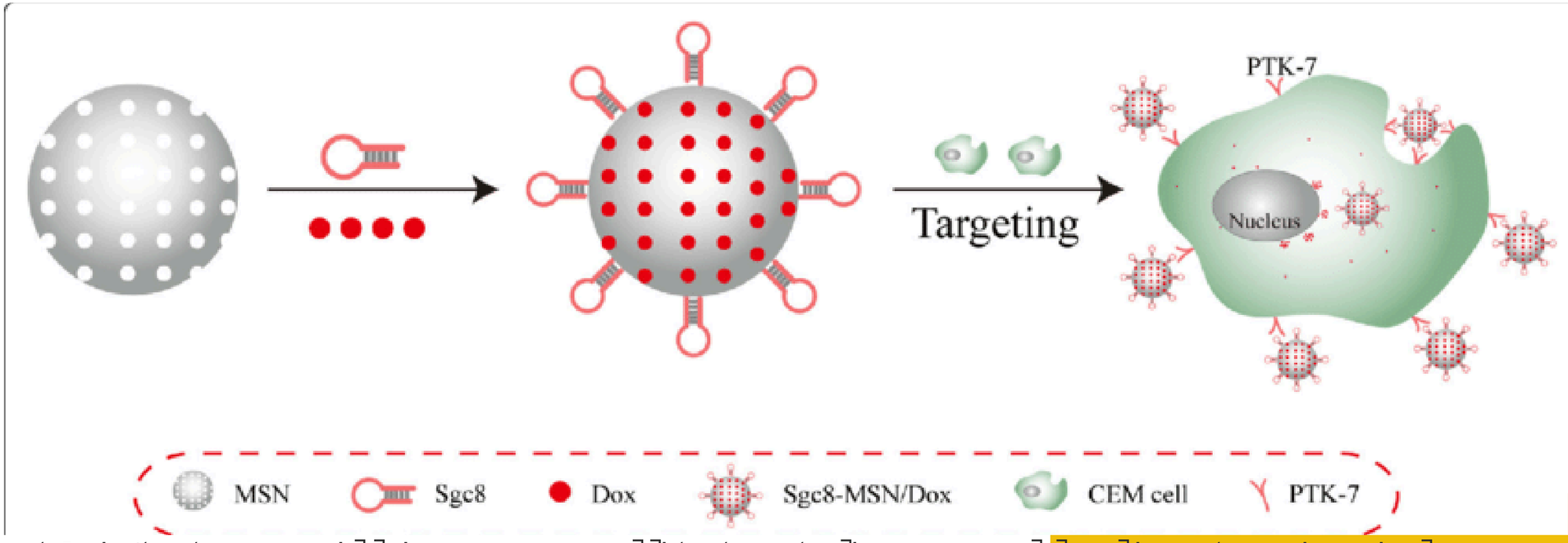

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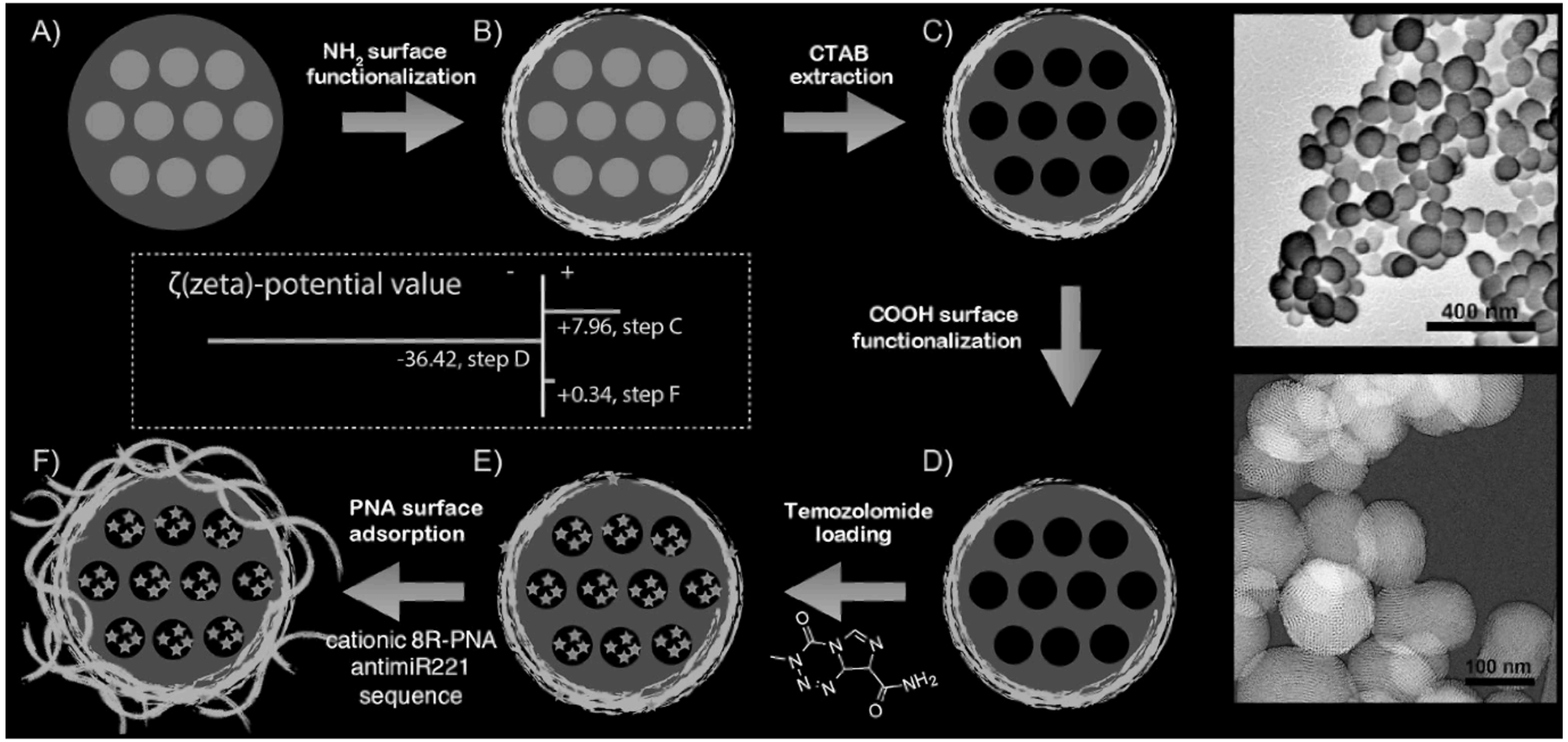

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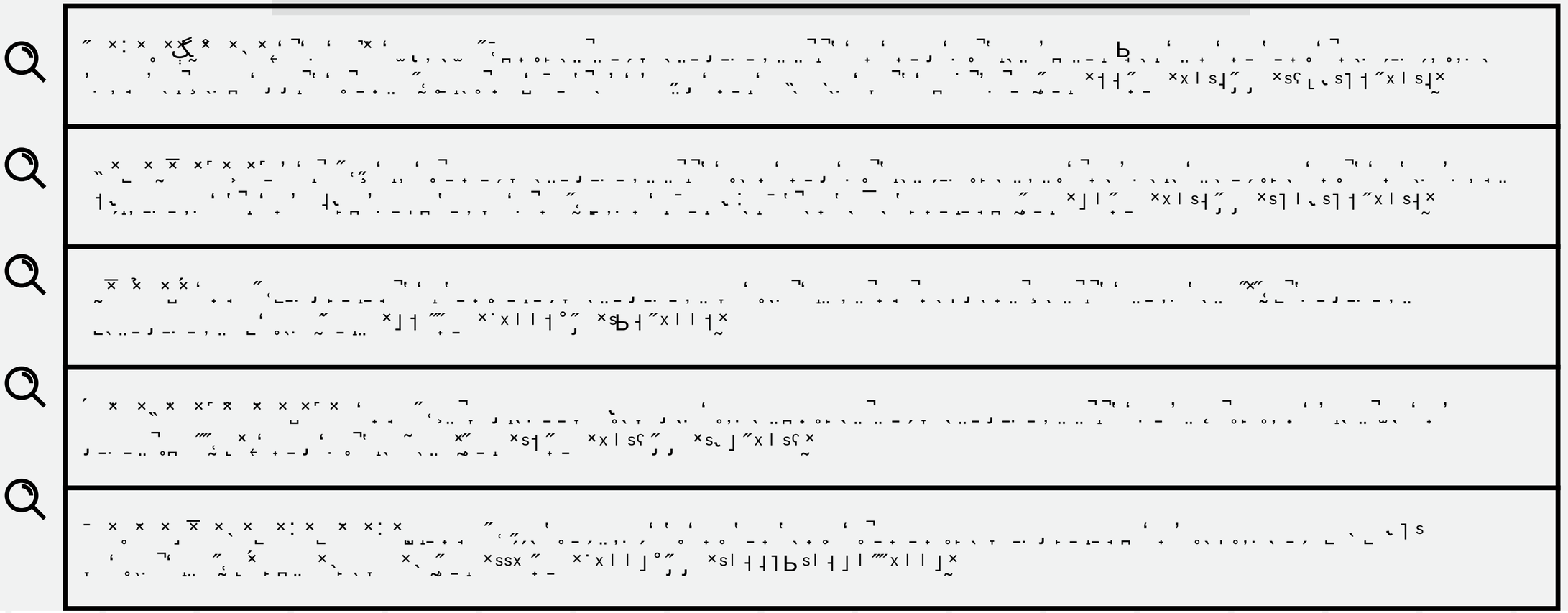
PENELUSURAN REFERENSI



PENELUSURAN REFERENSI

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- (ĸ(ĸ,ĸ)ĸ1ĸ2ĸ.=F?Лм+ =KGHGJGMK 1ADA;9 , 9FGH9JLA;D=K 9F< 5 9KL= "=JAN=<ɘ1ADA;=GMK + 9L=JA9DK >GJ "GPGJM:A;AF <KGJHLAGF 9F< 0=D=9K=ЛмĀ+ 9L=JA9D2G<9QЛĀGDĸржЛFGĸҐРржЛHHĸрFҐРɘрFҐғЛҐРржĸĀ
- 4ĸ!ĸ+ĸ+ĸ#ĸ1ĸ!ĸ+ĸ ĸ$ĸ"ĸ#ĸ, A;MD=K;MЛм-HLAE AR=< E =L@G< >GJ HJG<M;AF? E =KGHGJGMK KAD;9 >JGE AF;AF=J9LAGF 1&ĸЛмĀ JG?J=KKG> !JQG?=FA;K 9F< 'KGLGH=K 1=H9J9LAGFЛĀGDĸҐҐЛFGĸҐЛHHĸ5ғɘ5ЛҐРржĸĀ
- ĸ'ĸ ĸ+ĸ1ĸ1ĸ3ĸ, 9KLALA1AKO A'F<J9KLAЛм1QFL@=KAKG> , 9FGKADA;9 >JGE GAD=J K@AF L@= 1M?9J !9F= 'F<MKLJQ MKAF? L@= .J=;AHAL9LAGF + =L@G<ЛмĀFL=JF9LAGF9D(GMJF9DG>2=;@FGDG?QÖ(2=;@öЛĀGDĸррЛFGĸҐЛHHĸFҐҐɘFҐғЛҐРҐРĸĀ
- Ґĸ9ĸ1ĸ,ĸ ĸ(ĸ$9D9@ RAR9@#DE 9JA9рЛм+ 9?F=LA; , 9FGH9JLA;D=K :9K=< GF , 9LMJ9D1ADA;9 9K9 + =L@QD#KL=J $GJE AF? ;A< !9L9DQKLЛмĀ(MJF9D)AE A9 2=J9H9F 'F<GF=KA9ЛĀGDĸҐғЛFGĸҐЛHHĸFжɘFЛҐРҐрĸĀ
- ŸĸЛĸ+ĸ ĸ8ĸрĸЛĸ+ĸ"ĸҐĸЛĸ)ĸ1ĸҐĸЛĸ1ĸ2ĸ)ĸғĸЛĸ(ĸ1ĸ5ĸ5ЛĸĸЛĸ $ĸ5ĸ5ĸ9ĸ&ĸ+ĸЖĸ+ 9KGM< + AR9=AрЛм1ADA;9 + =KGHGJGMK 1LJM;LMJ=Kл#>>=;LAN= , 9FG;9JJA=JKAF "JM? "=DAN=JQ 9F< , 9FG;9L9DQKLKЛмĀ HHDA=< 1;A=F;=ЛĀGDĸрРЛHHĸFɘҐЛҐРҐРĸĀ

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