دانشگاه صنعتی اصفهان

صنایع لبنی تکمیلی

دکتر علی نصیرپور
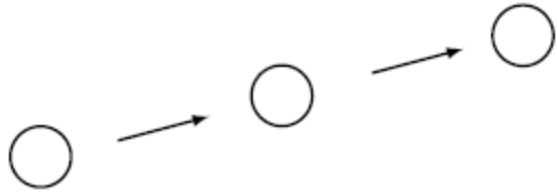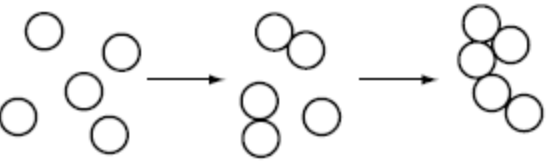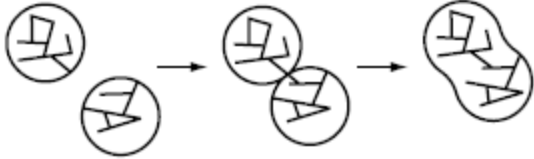
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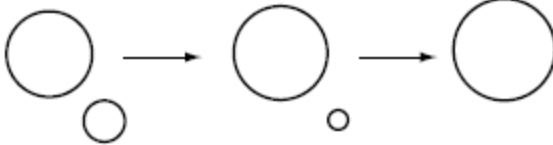
Type of change		Particles involved
Creaming		F, A
Aggregation		C, F
Coalescence		F, (C), A
Partial coalescence		F
Ostwald ripening		A

FIGURE 3.1 Illustration of the various changes that can occur with colloidal particles. A is air bubbles (diameter, e.g., 50 μm), C casein micelles (e.g., 0.1 μm), and F fat globules (e.g., 3 μm). The solid lines in the fat globules (partial coalescence) denote fat crystals.

TABLE 3.1
Values of the Interfacial Tension (γ) of Some Systems

Between Phases	γ
Water–air, 0°C	76
Water–air, 25°C	72
Water–air, 60°C	66
Na laurate[a]–air	43
Protein solution–air	~50
Oil[b]–air	35
Oil–water	30
Protein solution–oil	~10
Ice–water, 0°C	25
Fat crystal[c]–water	31
Milk fat globule–milk serum	~1.5[d]
Fat crystal–oil	4

Note: Approximate values in $mN \cdot m^{-1}$ at 25°C, unless stated otherwise. The values involving a solid interface are rough estimates.

[a] 0.02 *M* aqueous solution.
[b] Pure triglyceride oil.
[c] Pure triglyceride crystal.
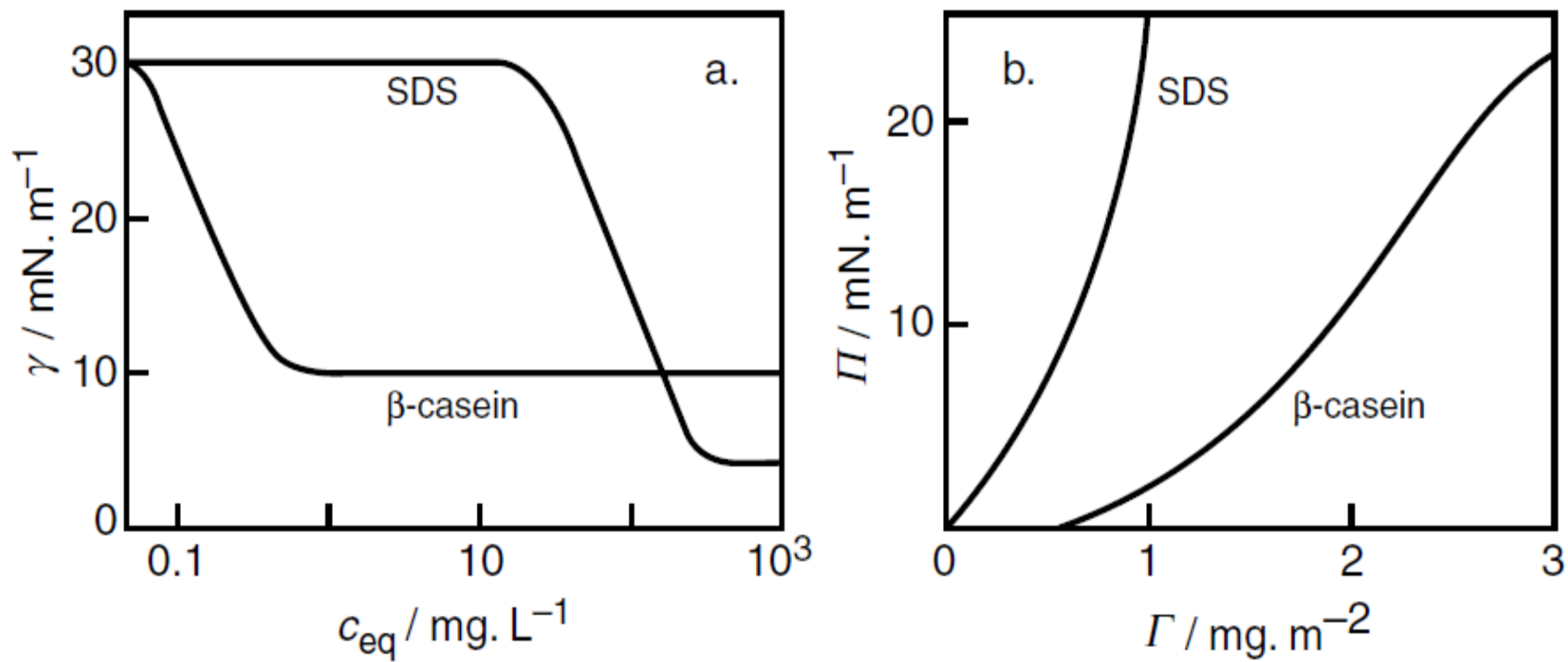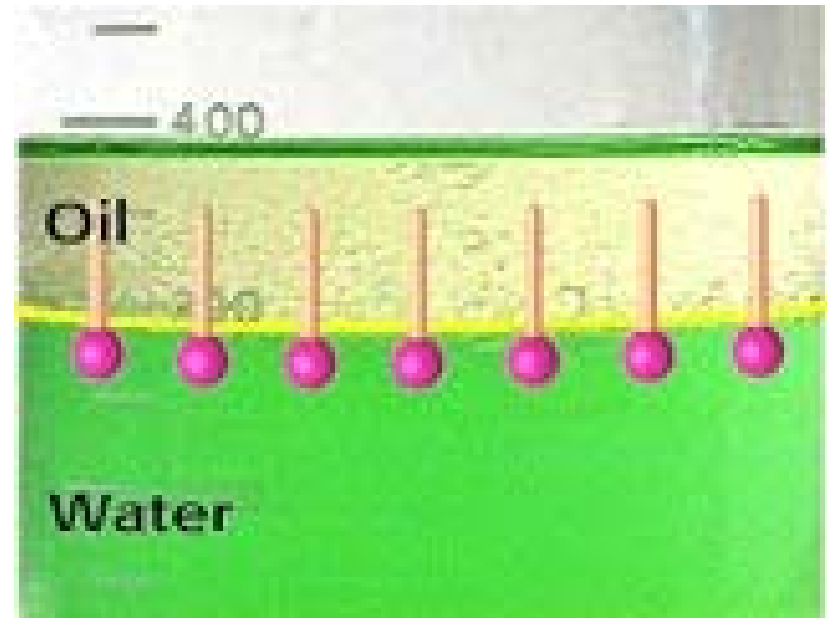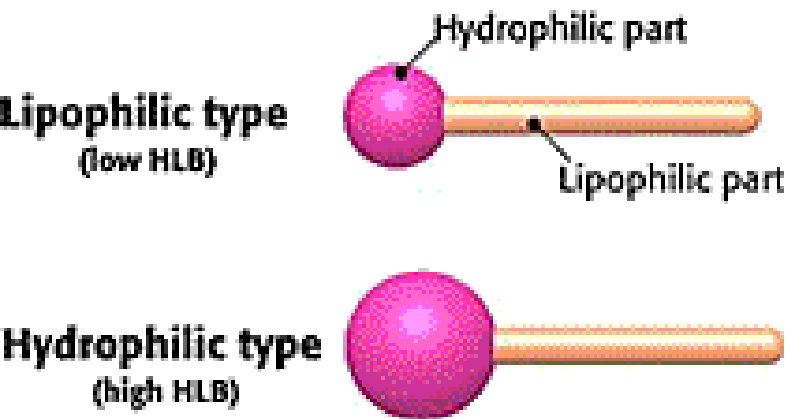[d] Measured values range from 0.9 to 2.5.

FIGURE 3.2 Adsorption of β-casein and SDS (sodium dodecyl sulfate) at an oil–water interface. (a) Interfacial tension γ as a function of equilibrium surfactant concentration c_{eq}. (b) Relation between surface pressure $\Pi = \gamma_0 - \gamma$ and surface load Γ. Approximate results.

Hydrophilic part

Lipophilic type
(low HLB)

Lipophilic part

Hydrophilic type
(high HLB)

Oil

400

Water

strongly hydrophilic
High HLB

good balance
appropriate HLB

Oil

Water

strongly lipophilic
Low HLB

Characteristic behaviors related to water	HLB	ratio		functions		
		hydrophilic part	lipophilic part			
not dispersing	0	0	100			
				anti-foaming agent		
slightly dispersing	2	10	90			
	4	20	80			W/O emulsification
	6	30	70			
milky dispersion	8	40	60	wetting agent		
stable milky dispersion	10	50	50			
transparent dispersion	12	60	40			O/W emulsification
colloidal solution	14	70	30	cleaning agent		
	16	80	20	solubilizing agent		
	18	90	10			
	20	100	0			

type	HLB	W/O (4–7)				O/W (8–20)														
	HLB	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Monoglycerides	3~4
Acetylated monoglycerides	1
Lactylated monoglycerides	3~4
Citlated monoglycerides	9
Succinylated monoglycerides	5~7
DATEM	8~10
Polyglycerol esters	1~14
Sucrose esters	1~16
Sorbitan esters	2~9
CSL, SSL	7~9
Lecithin	3~4

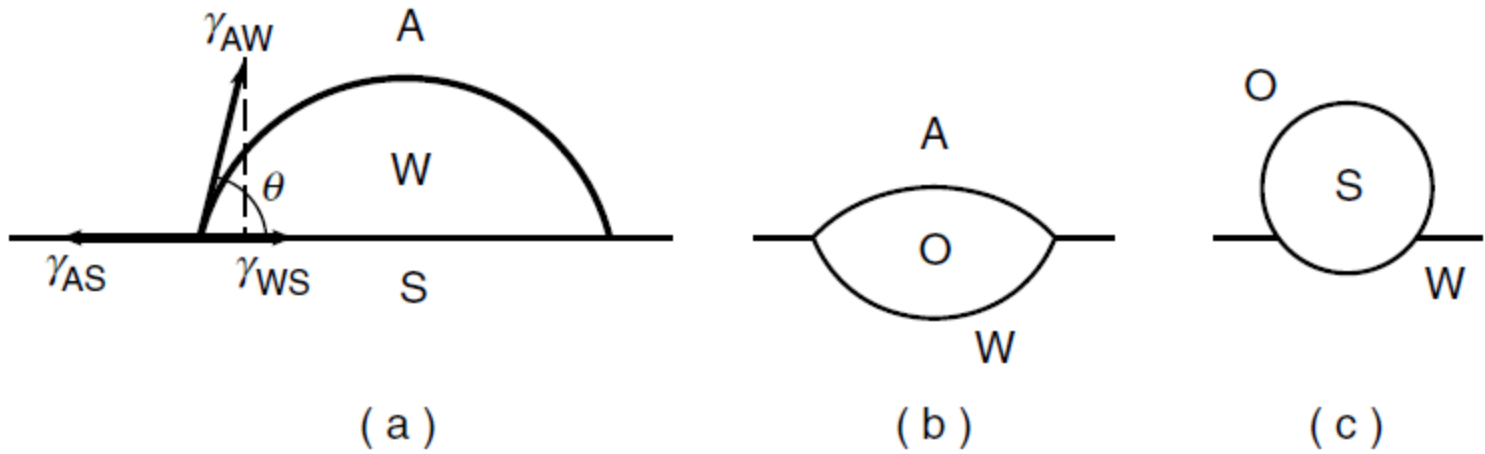**FIGURE 3.4 Contact angles (*q*). *Examples of three-phase systems: A = air, O = oil, S =* solid, and W = water. In (a) the relation *gAS = gWS + gAWcosq holds.***