

**Nano structured materials-synthesis, properties, self assembly and applications
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MODULE 2 (LECTURE 3, 4): MICROEMULSIONS

1. What are microemulsions.
2. What is the difference between micro & macroemulsion.
3. At what ratio of water/oil reverse micelles are formed
4. What is the driving force in the formation of micelle
5. What are surfactant.
6. What are the different types of surfactant.
7. What are biosurfactants and switchable surfactants.
8. Define the following:
 - a) W_0
 - b) C.M.C.
 - c) Kraft temperature
 - d) Surfactant packing parameter
9. What are reverse micelles
10. What is the role of co-surfactant in the formation of reverse micelle
11. What is the role of solvent in controlling the morphology of the product.
12. What is the role of co-surfactant in controlling the morphology of the product.
13. Define aspect ratio.
14. What informations are obtained from phase diagram study.

MODULE 2 (LECTURE 3, 4): MICROEMULSIONS

Solution:

1. Microemulsion: thermodynamically stable, optically transparent isotropic dispersions of aqueous and hydrocarbon liquids stabilized by an interfacial film of surfactant molecules.
- 2.

Microemulsion	Macroemulsion
Thermodynamically stable	Kinetically stable
Droplet size 10-100 nm	1-10 μ m
High surface area	Low surface area
Forms at critical packing parameter(CPP) = 1	CPP > or < 1

3. Water/oil \ll 1
4. In water, the hydrophilic "heads" of surfactant molecules are always in contact with the solvent, regardless of whether the surfactants exist as monomers or as part of a micelle. However, the lipophilic "tails" of surfactant molecules have less contact with water when they are part of a micelle—this being the basis for the energetic drive for micelle formation. In a micelle, the hydrophobic tails of several surfactant molecules assemble into an oil-like core, the most stable form of which having no contact with water surfactant. Micelles can form spontaneously because of a balance between entropy and enthalpy. In water, the hydrophobic effect is the driving force for micelle formation, despite the fact that assembling surfactant molecules together reduces their entropy.
5. Surfactant: Surfactants are compounds that lower the surface tension between two liquids or between a liquid and a solid. Posses a polar head group and non-polar hydrocarbon tail.
6. Anionic, Zwitterionic, cationic and non ionic
7. Bio surfactant: surface-active substances synthesised by living cells e.g.sophorolipids
Switchable surfactant: The switchable surfactants are molecules that can be reversibly converted between surface active and inactive forms by application of triggers. e.g. N, N-di(propylamino) dodecylamine
8. W_0 : water to surfactant ratio
CMC: minimum concentration of the surfactant at which micelle formation takes place.
Kraft temperature: temperature at which the solubility equals the CMC
Surfactant packing parameter: gives an idea of the aggregates formed, given by the expression
 $N_s = v/a l$
 N_s - surfactant packing parameter
V - volume of the hydrocarbon chain of surfactant molecule
a - effective area per polar head group

- l - length of hydrophobic part (optimal length close to the fully extended)
9. Reverse micelles: nanometer-sized water droplets dispersed in organic media obtained by the action of surfactants.
 10. Surfactants do lower the interfacial tension, but in most cases the C.M.C. (critical micellar concentration) or the limit of solubility is reached before the interfacial tension is close to zero. Addition of second surfactant of a completely different nature then lowers the interfacial tension further.
 11. Solvent interact with the surfactant tail affecting the intermicellar exchange. Bulky solvent cannot penetrate the surfactant tails and more fluid at the interface enhances the intermicellar exchange. When solvent is bulky large sized particles are formed.
 12. Role of co-surfactant: effective synergic co-operation of the alkyl chains of the co-surfactant with the surfactant tails at the micellar interface leads to more rigid structure which accounts for reduced coalescence rate and thereby producing particles of smaller dimensions.
 13. Ratio of length to diameter
 14. A phase diagram is the compact graphical representation of phase boundaries of any feasible system. It provides clue to macroscopic behavior which can be linked to the particle or molecular interactions. We can study inter-aggregate interactions by observing phase behavior. A very convenient method for the preparation of a phase diagram is the titration method. A surfactant is dissolved in aqueous medium and is titrated with the organic phase. The transition points are noted. The single-phase, optically transparent domains correspond to the microemulsions whereas turbid zones are for multiphasic systems.