Thomas Zemb

lecture n°2:

Coexistence of fluids: lessons from phase diagrams

-binary phase diagram : cloud point extraction

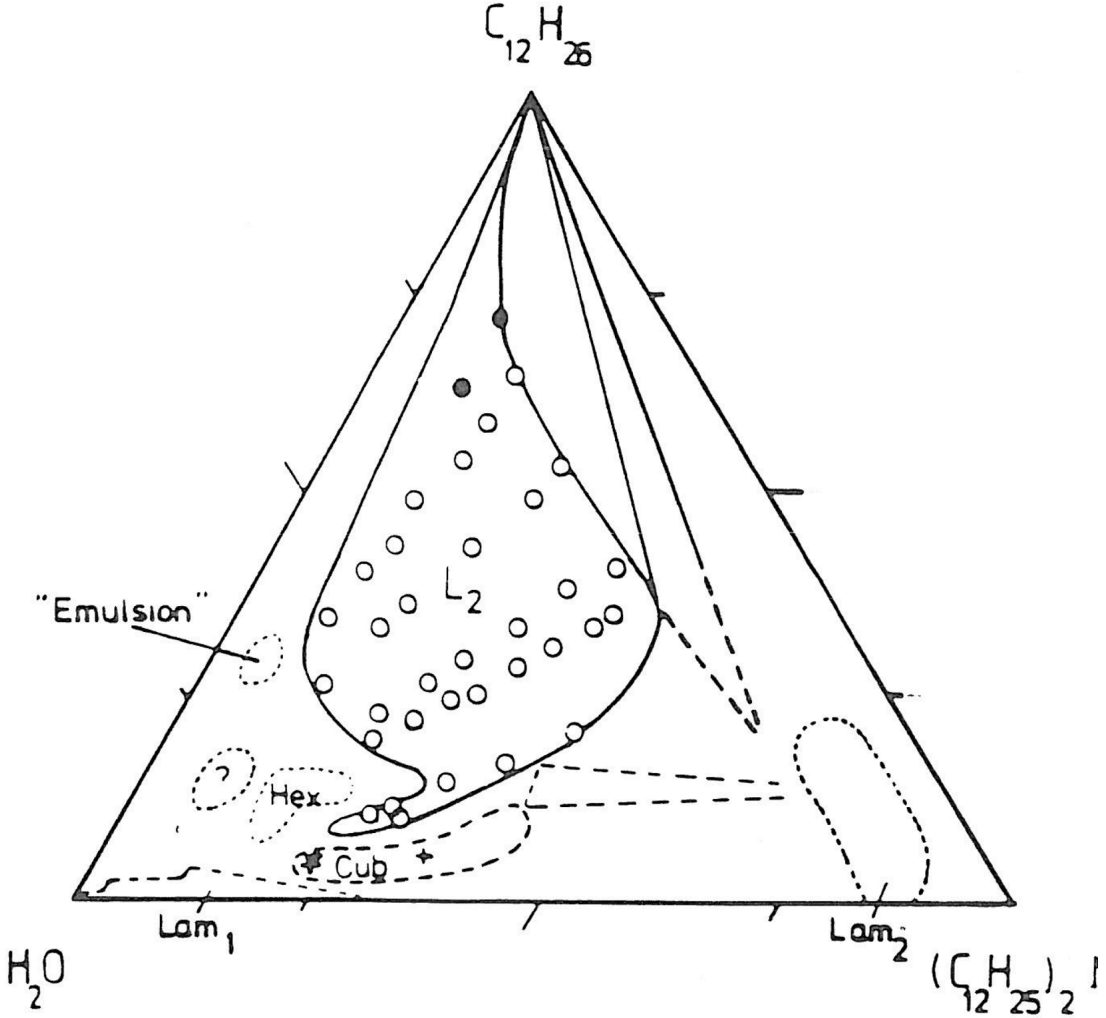
-ternary phase diagram : Winsor II extraction

Content

- **Binary phase diagrams**:

  Reading a binary phase diagram : CiEj-water
- Effect of adding a salt
- Separation and temperature cycling
- **Ternary phase diagram**:
- „Flexible" and „rigid" case
- The extended Winsor II regime
- The formulation limit and phase boundaries
- The „alternating cascade" for separation

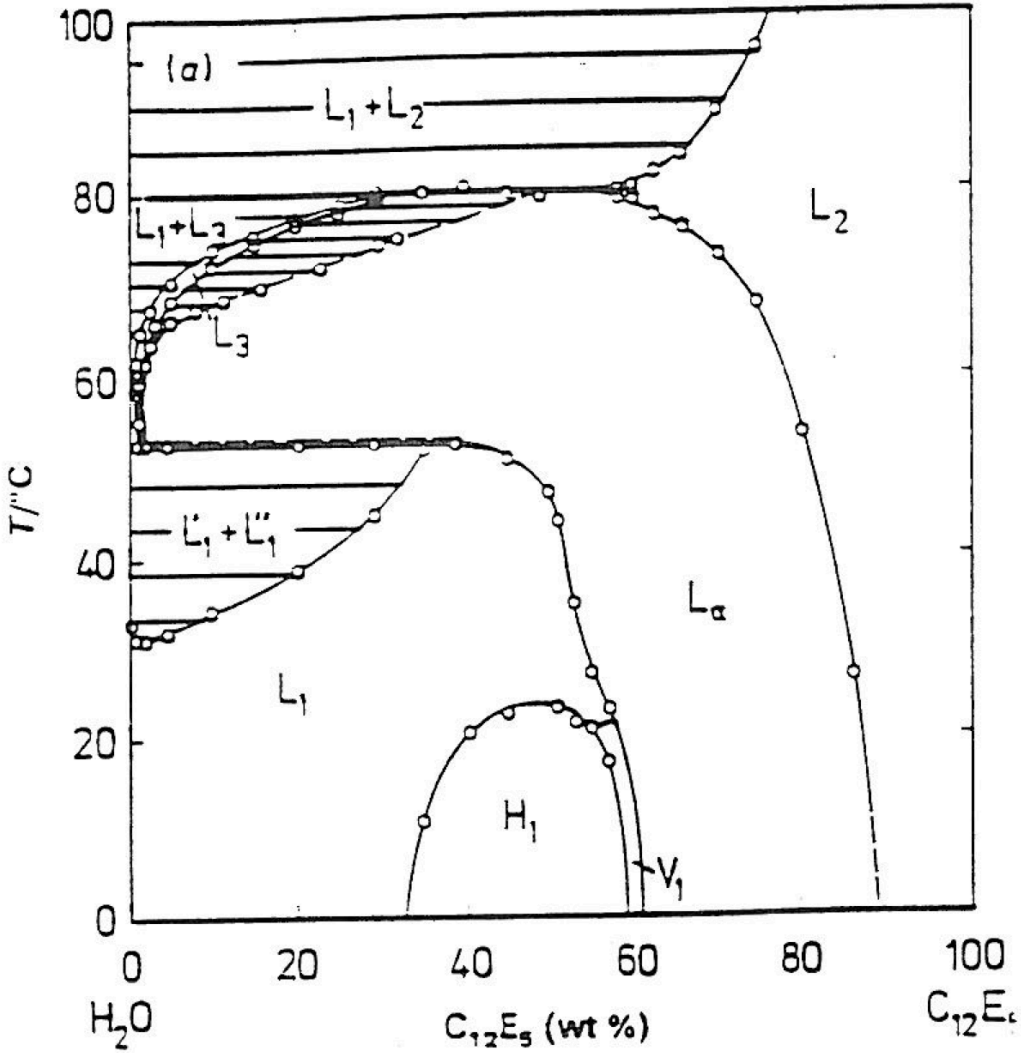
Lecture of a phase diagram: Experimentalist/ Engineer



Colloidal/"nano"/Meso eye :surfaces curvature

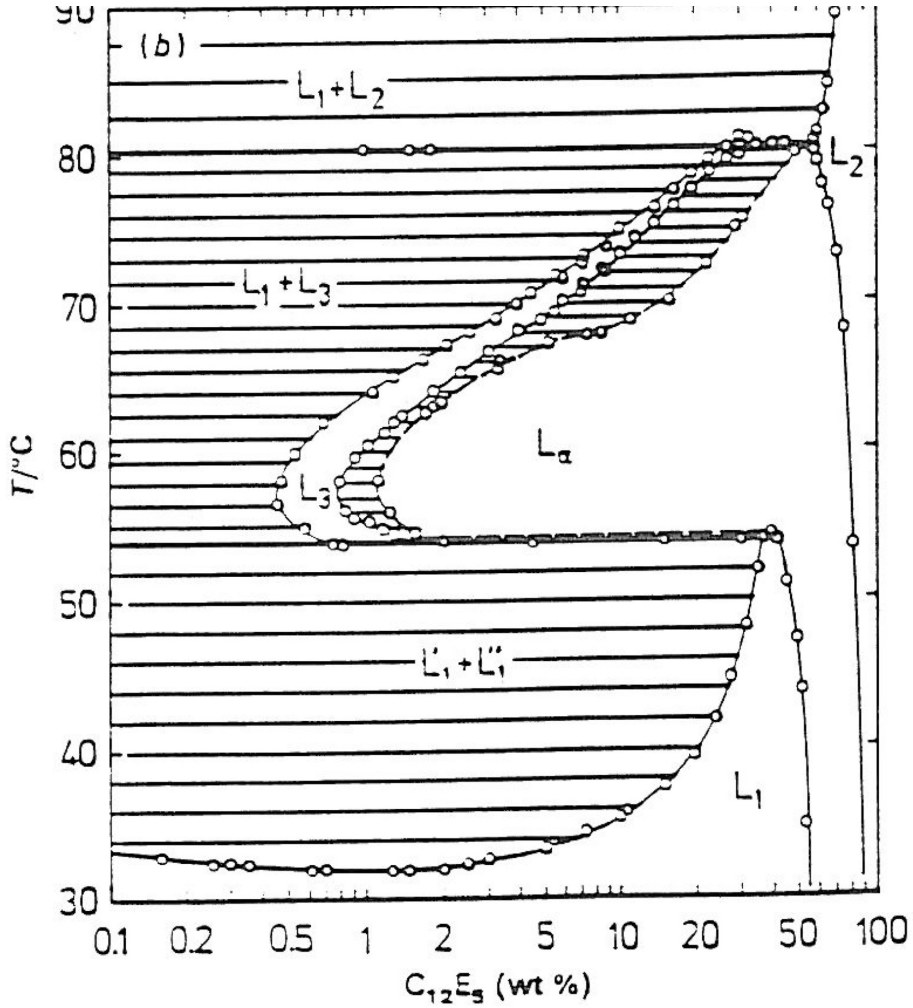
Interaction/Foreces/Potentials: free energy

Reading a binary phase diagram : CiEj-water



Chevalier Y, Zemb T. The structure of micelles and microemulsions. Rep Prog Phys 1999;53:279–371.

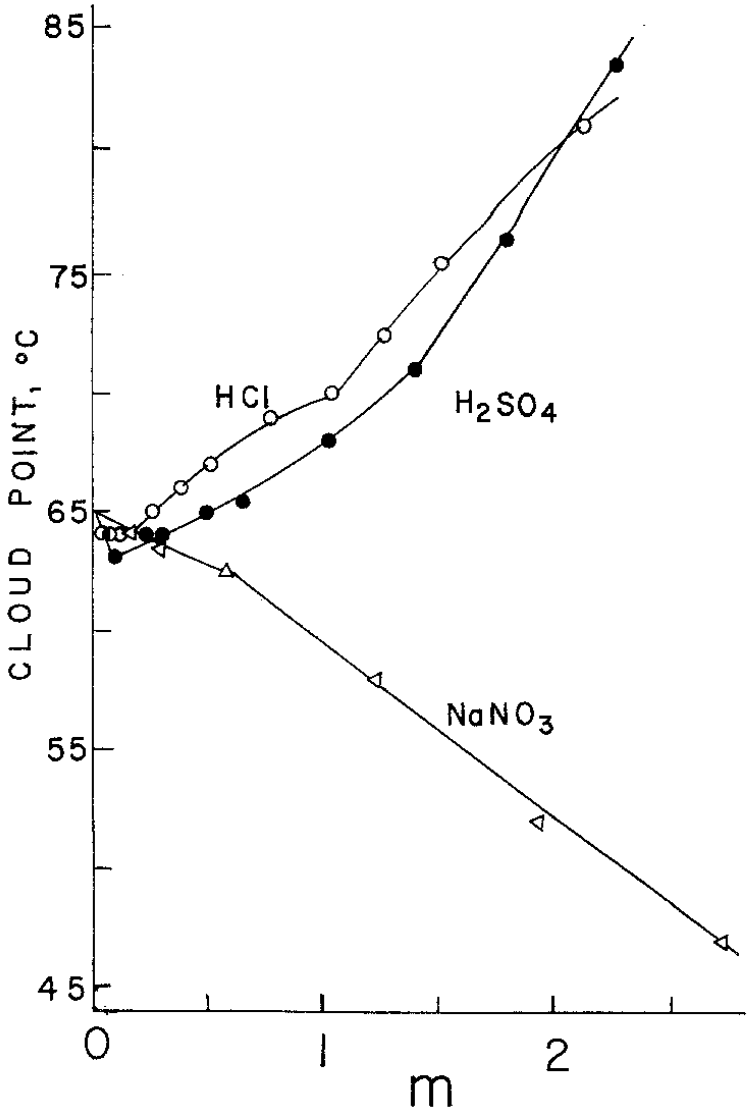
Reading a binary phase diagram : a(CiEj-water)



Colloidal forces :Wennerström H, Lindman B. Micelles. Physical chemistry of surfactant association. Physics Reports 1979;52:1–86.

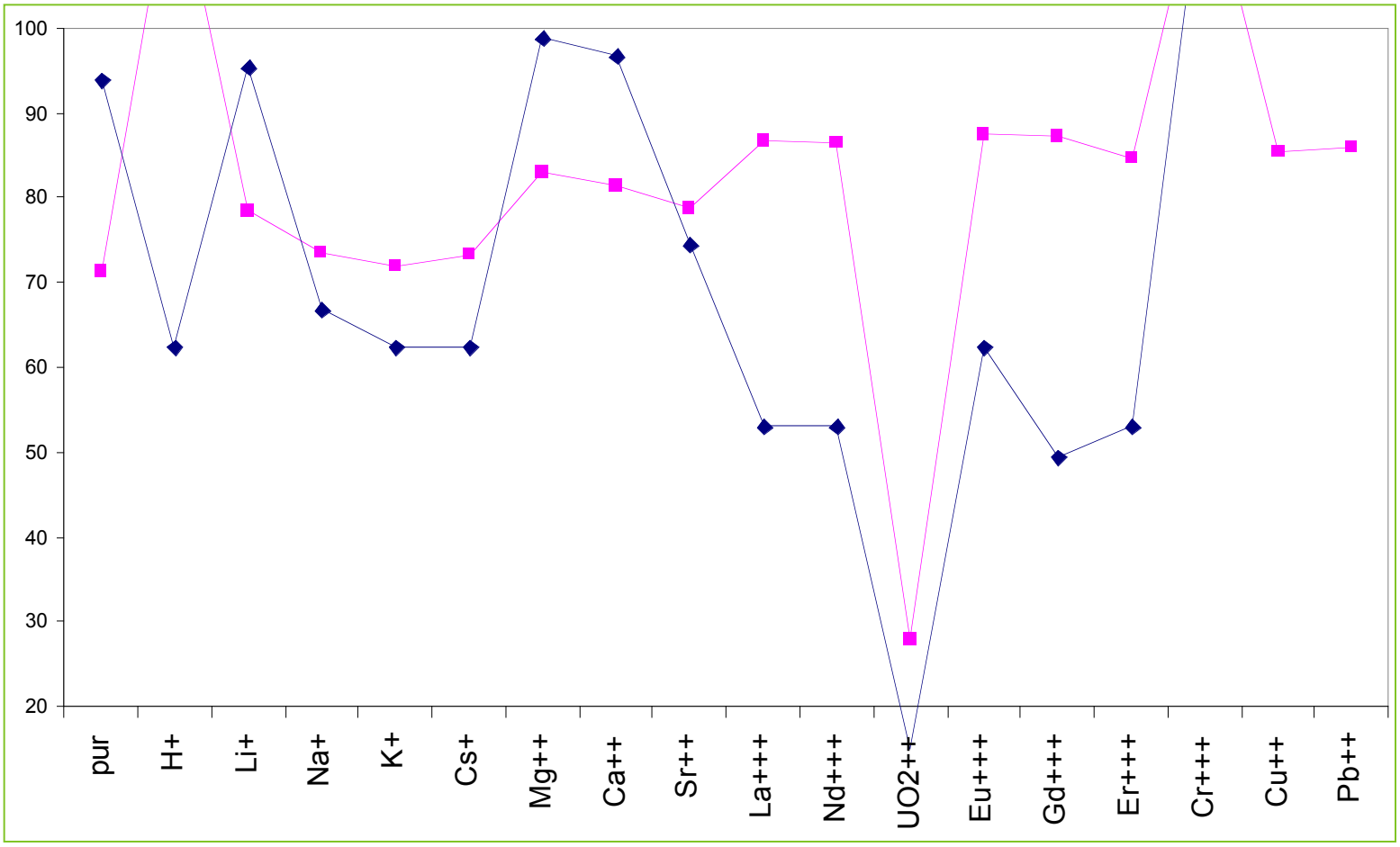
Mesostructure : Chevalier Y et ThZ The structure of micelles and microemulsions. Rep Prog Phys 1989;53:279–371.

Effect of adding salts

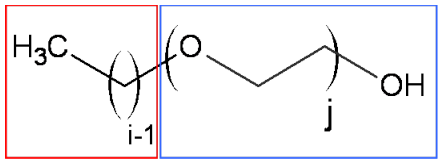


SCHOTT H. Salting in of Nonionic Surfactants by Complexation with Inorganic Salts. Journal of Colloid and Interface Science 1973;43:150–5.

The separation via T-cycling



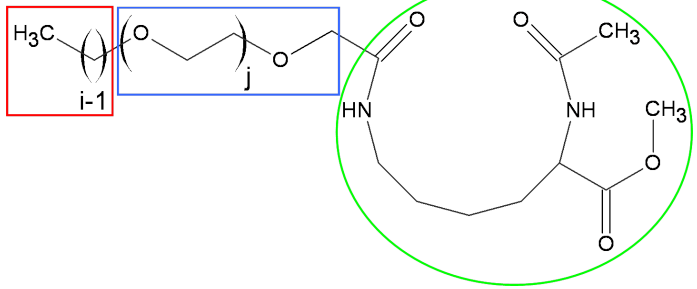
Effect on Thermosensitive complexants



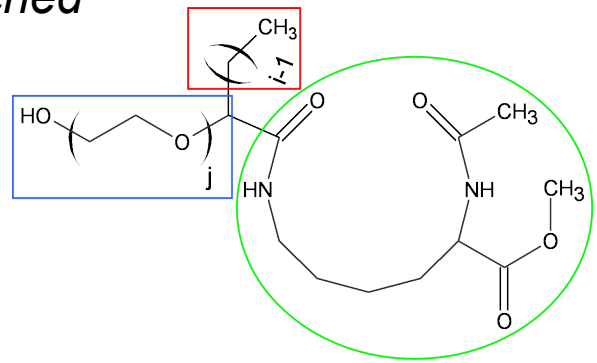
Nonionic precursor:
CiEj, n-alkyl polyoxyethylene glycol

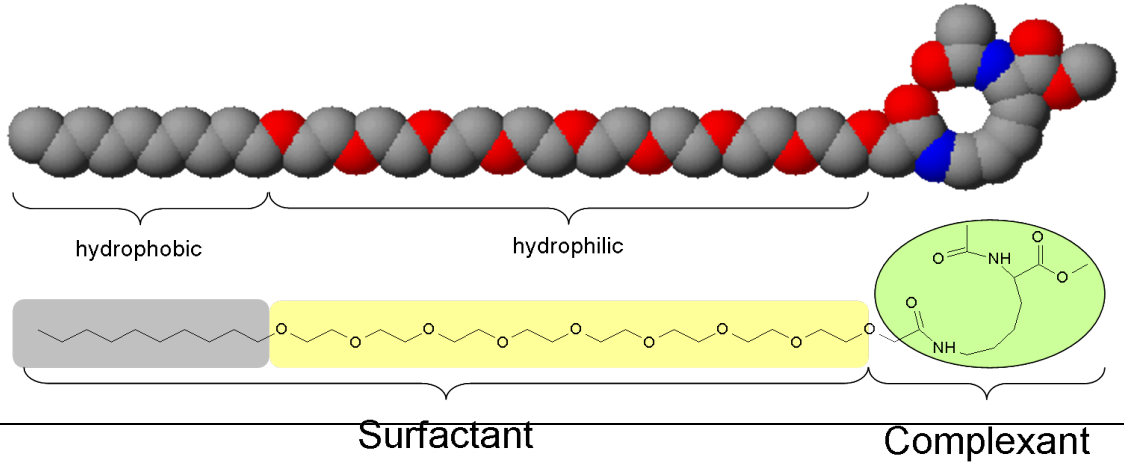
\+ Complexing group: amino-acid (lysine)

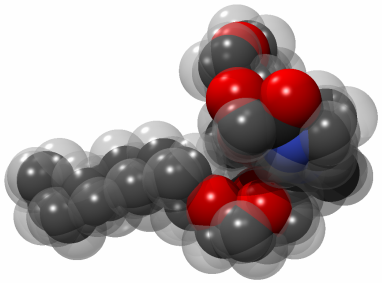
- *linear*



- *branched*

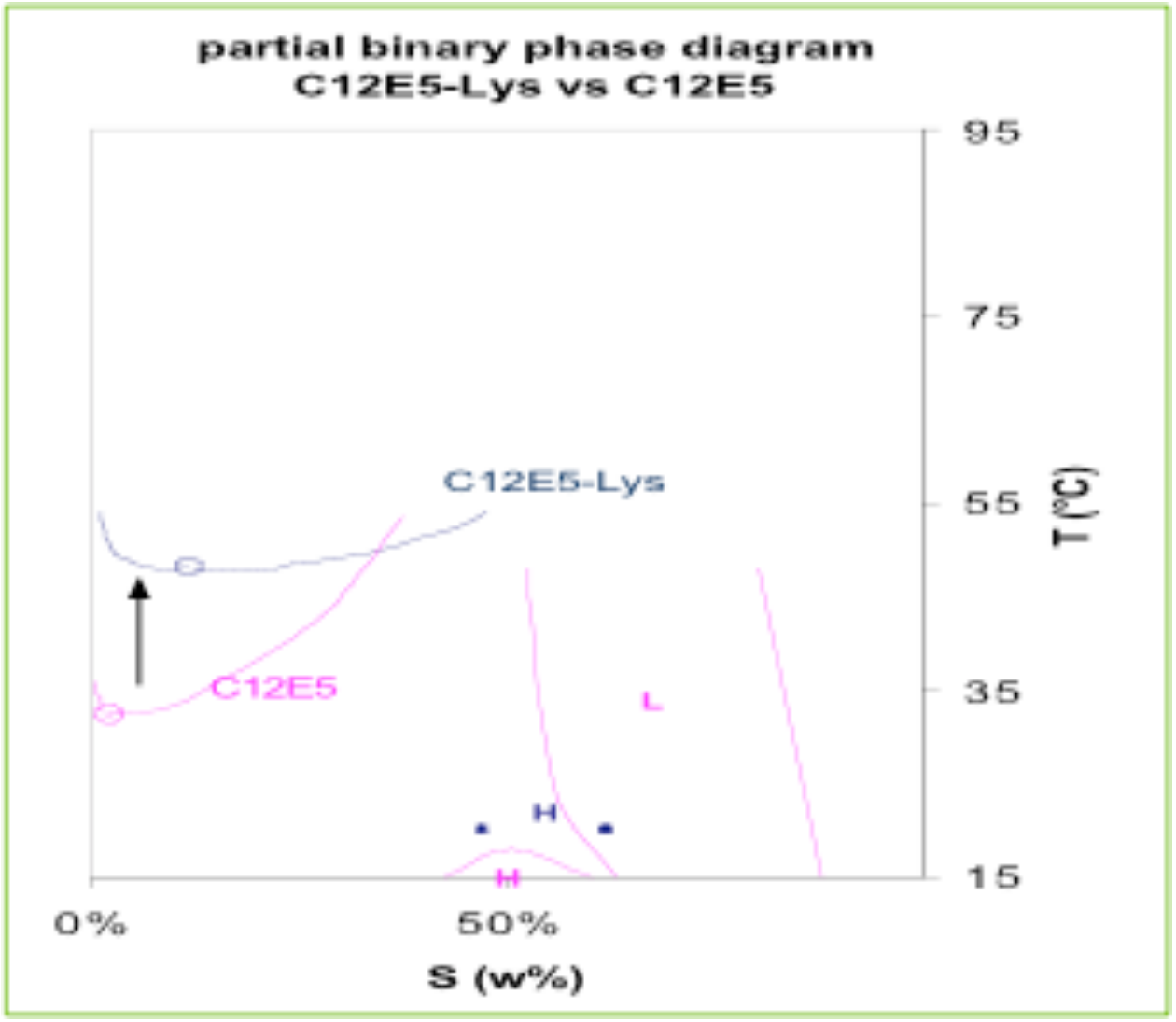






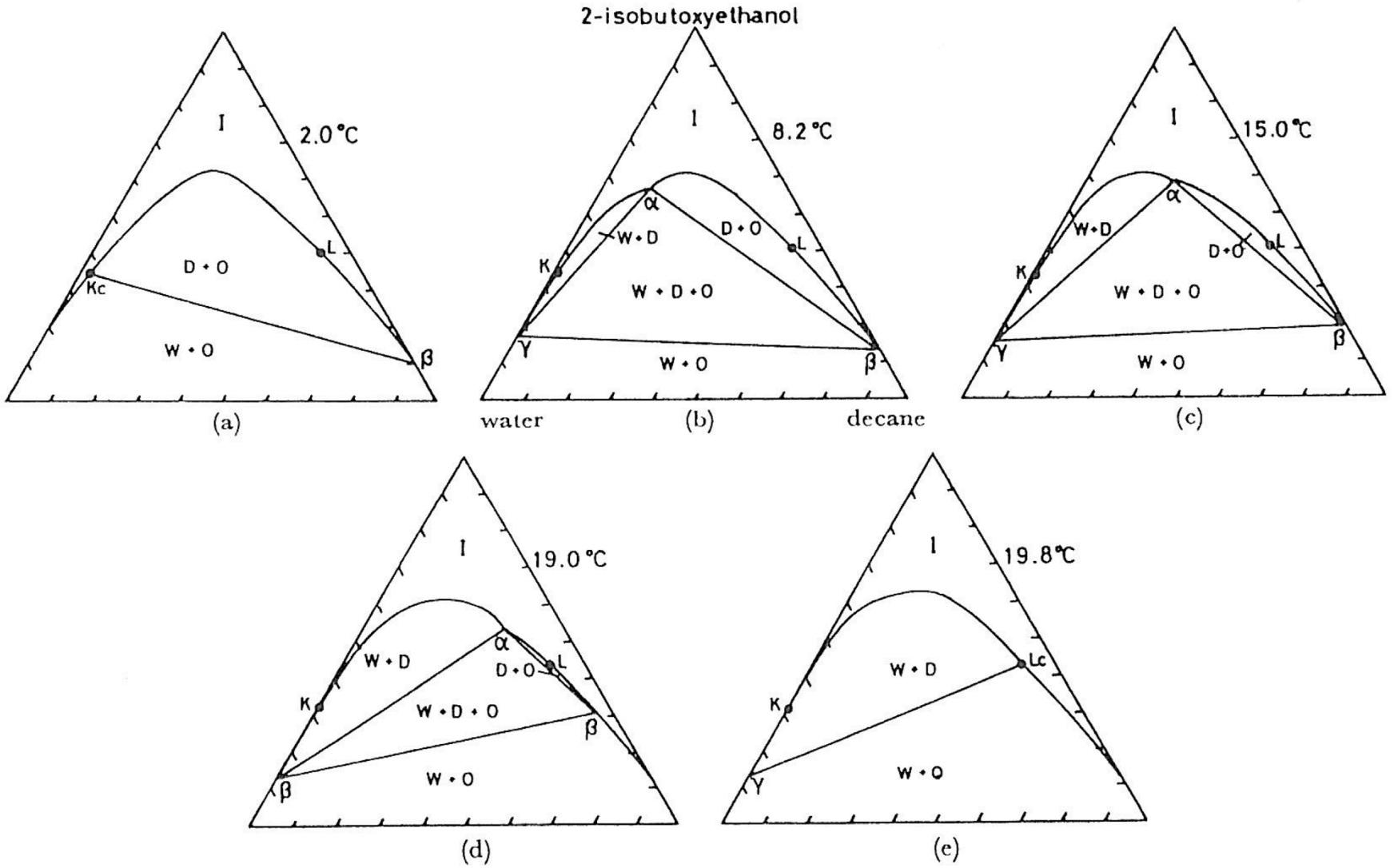
C10E8-Lys

Phase diagrams



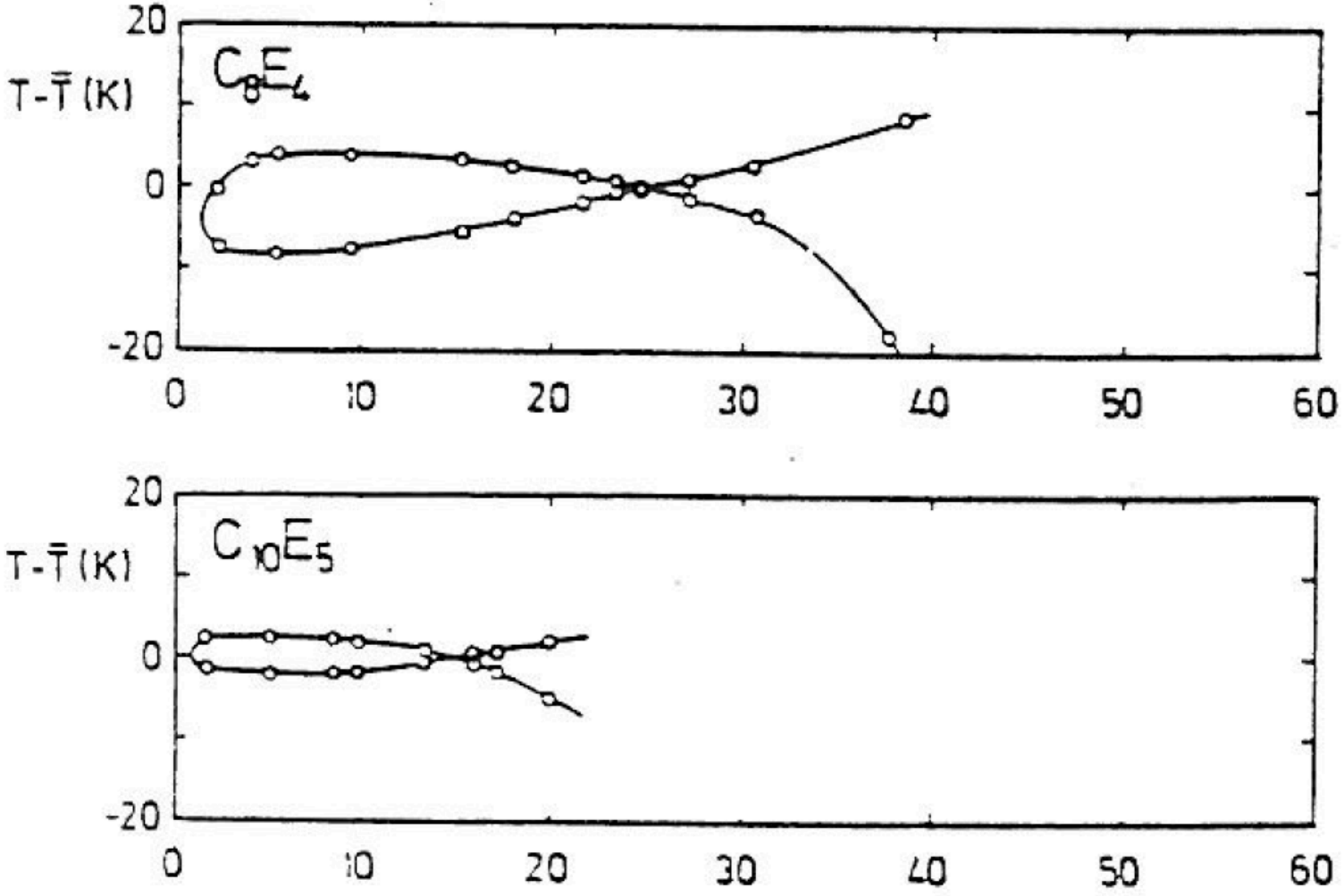
Coulombeau H et al.; Effect of recognized and unrecognized salt on the self-assembly of new thermosensitive metal-chelating surfactants. Langmuir 2004;20:4840–50

Ternary phase diagram: reading



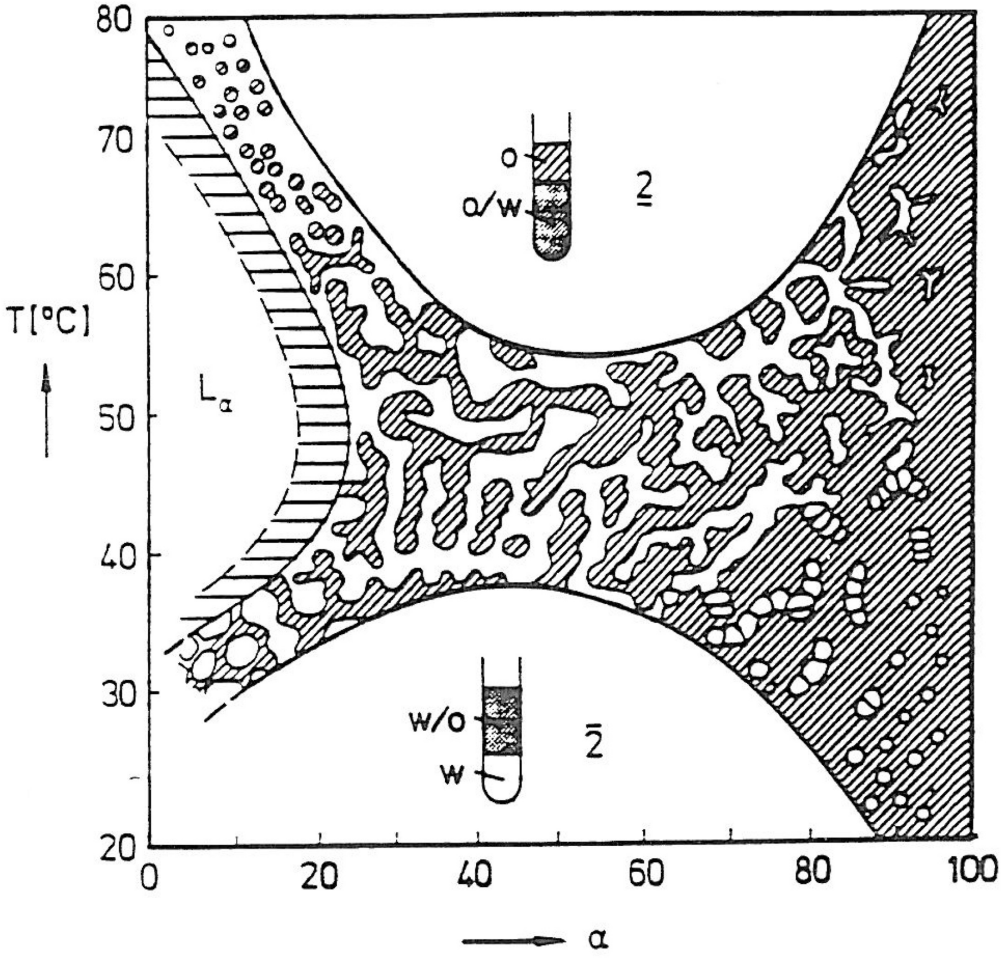
Kunieda Hand Shinoda-1980

Flexible case : curvature (fish) cut



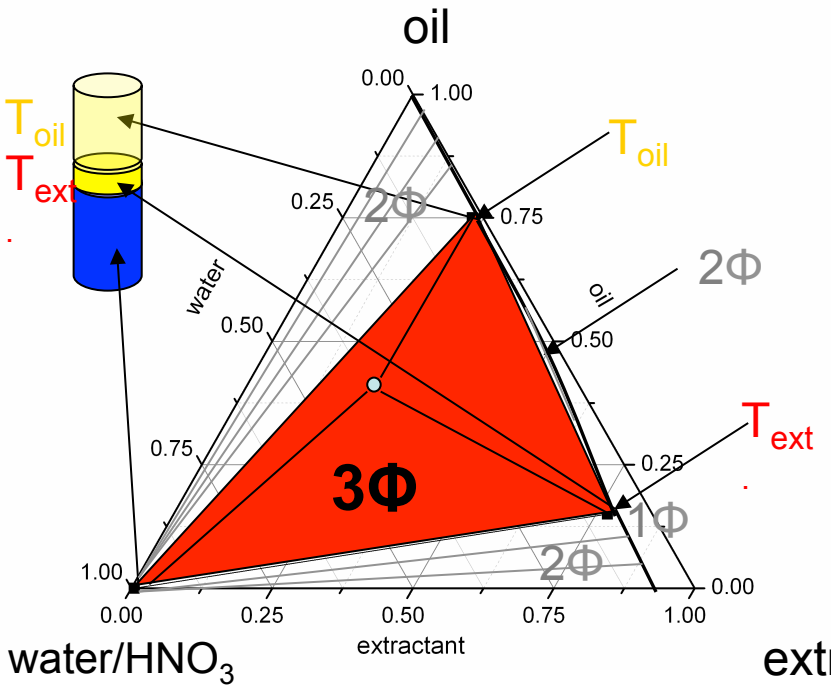
Kahlweit M, Strey R and Busse G.; Phys Rev E47 (1993) 4197

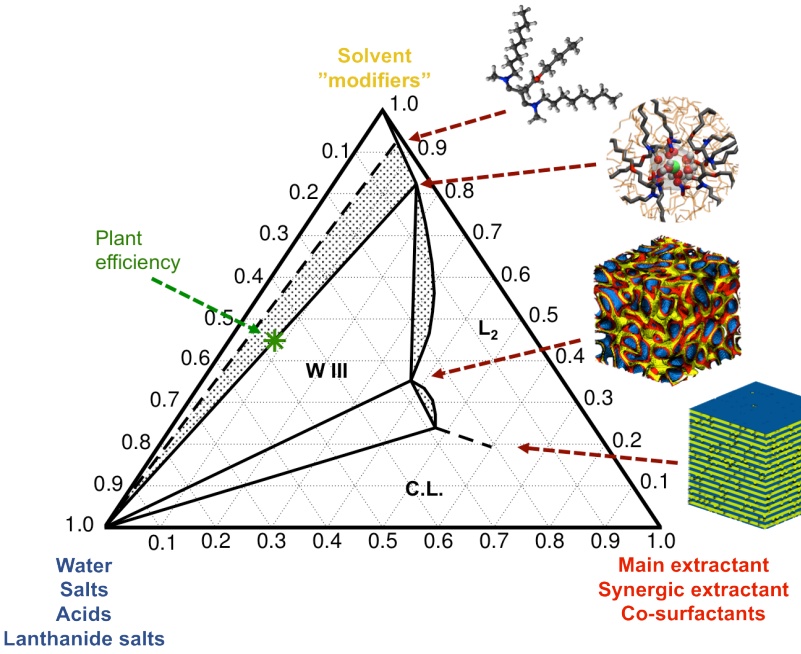
Flexible case : topology cut



S. H. Chen, S. L. Chang et R. Strey
Journal of Chemical Physics 93 p. 1907 (1990)

Microemulsions containing extractants ?

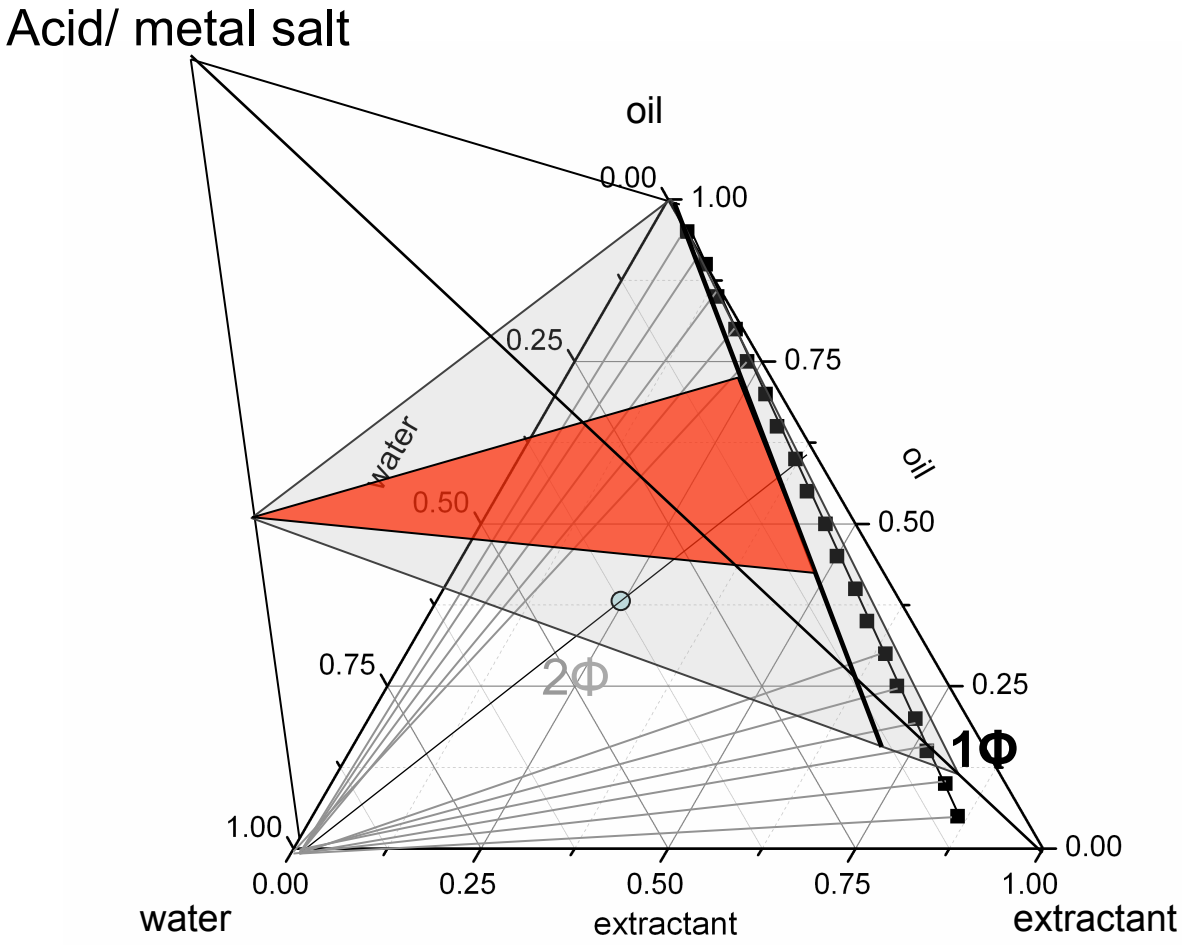




Formulation : Extractant (p_0=2) and detergent (p_0= 1/3) ?

C. Bauer and O.Diat

Microemulsions containing extractants ?



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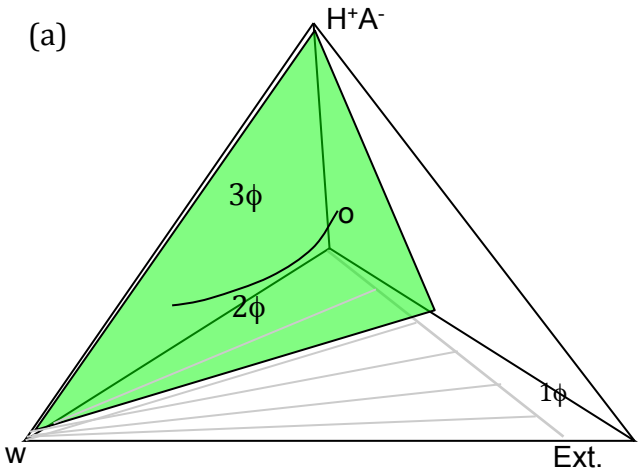
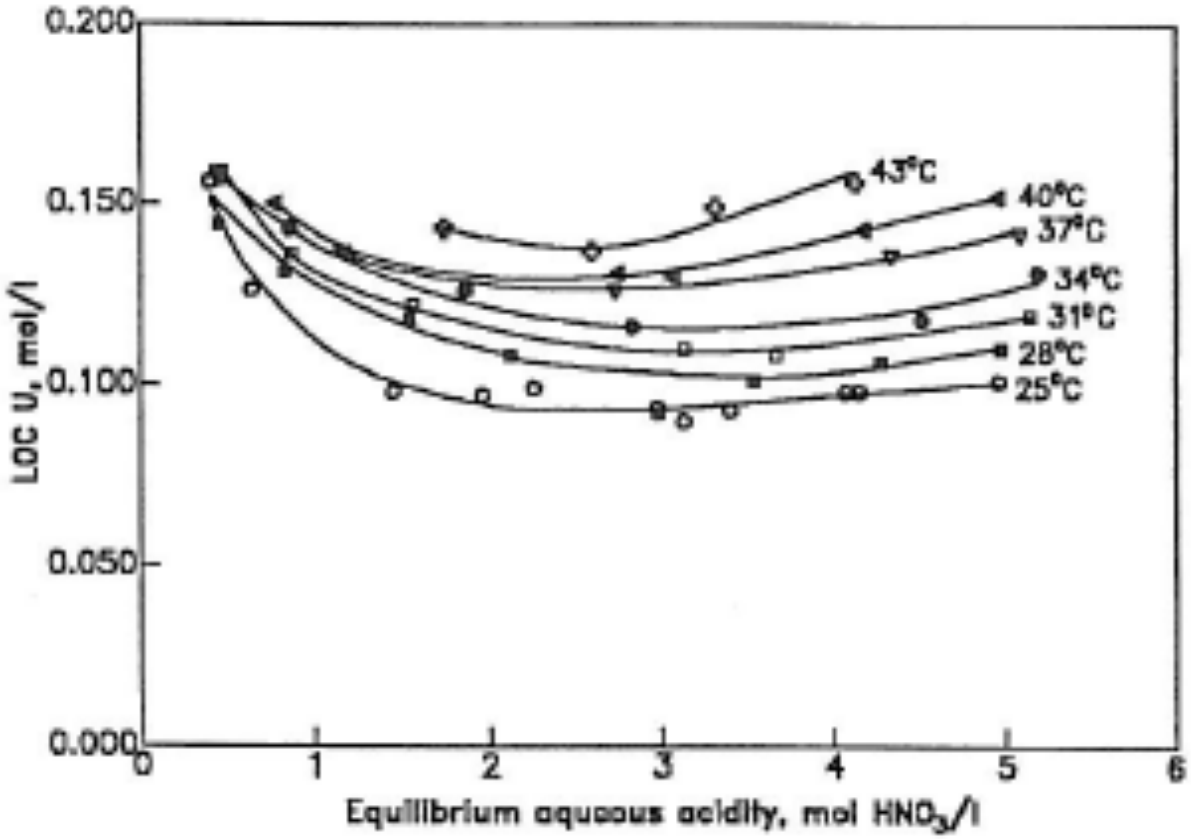
C. Bauer and O.Diat

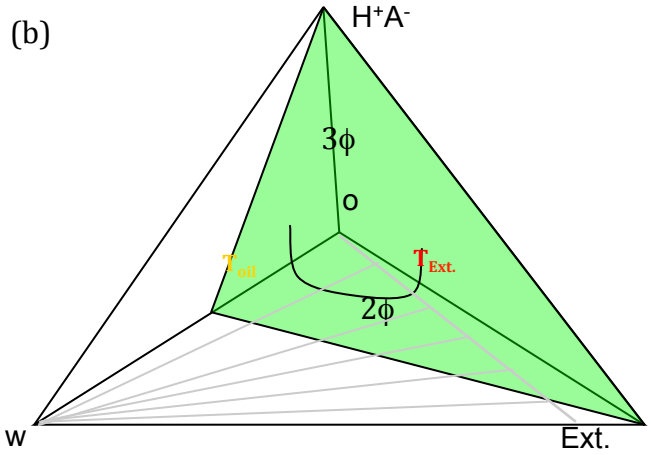
Identification of phase limits in chem. engineering

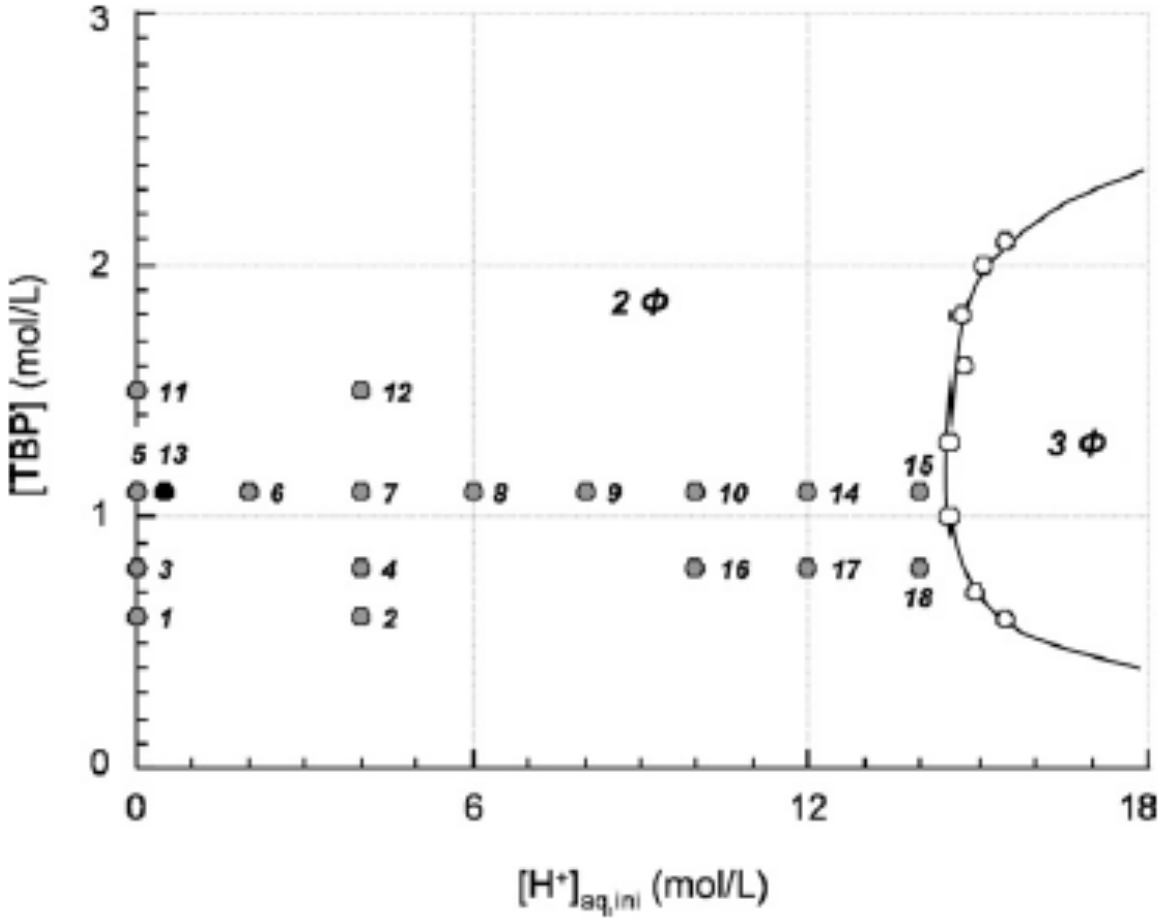




Bauer C et al., Liquid/liquid metal extraction:
Eur Phys J Spec Top 2012;213:225–41.

Identification of phase limits in chem. engineering





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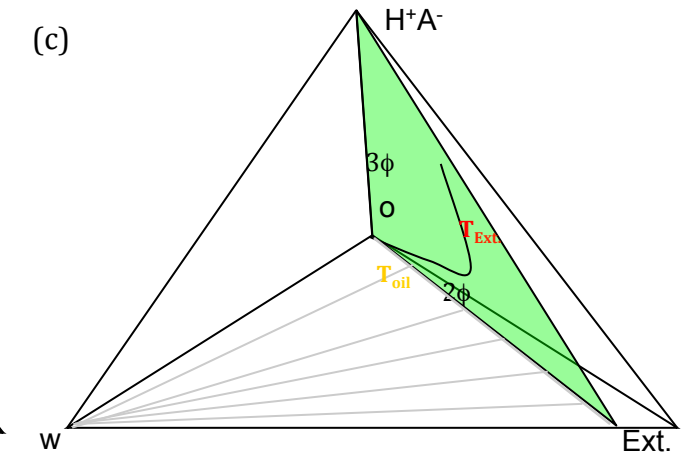

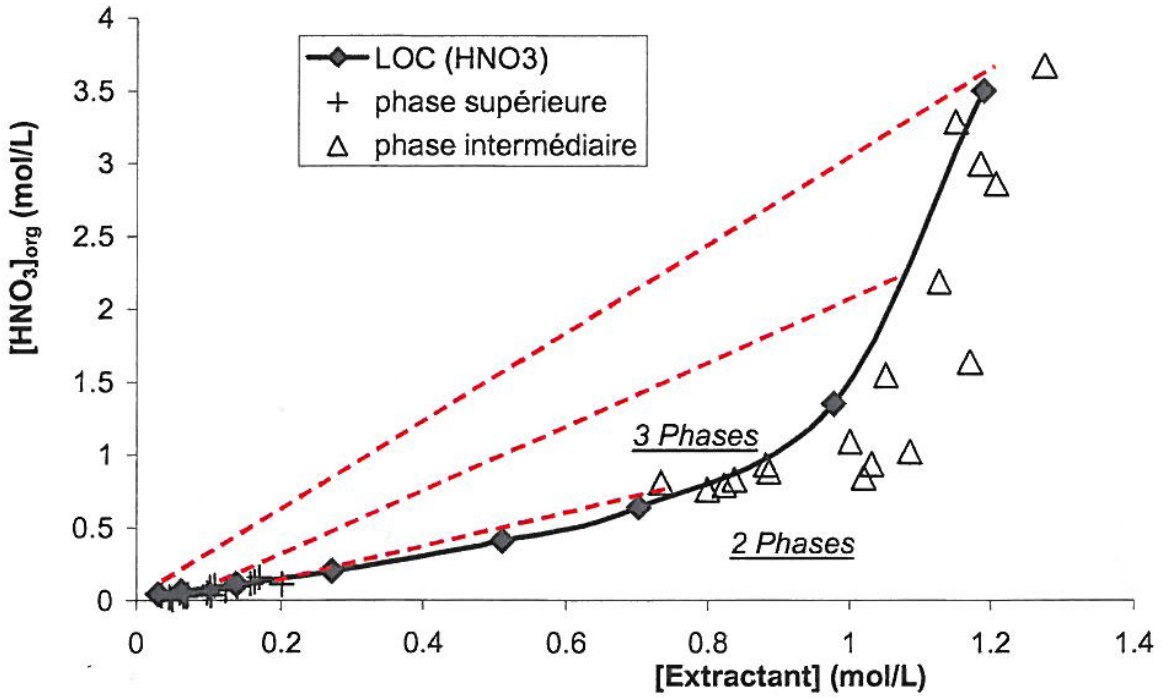

Bauer C et al., Liquid/liquid metal extraction:
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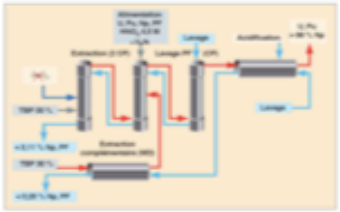
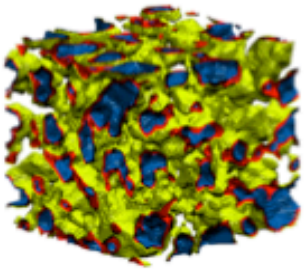
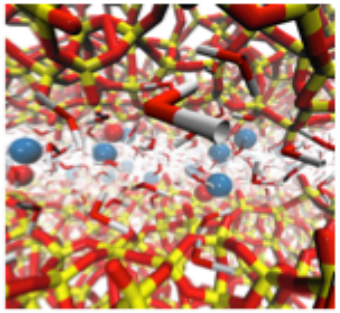
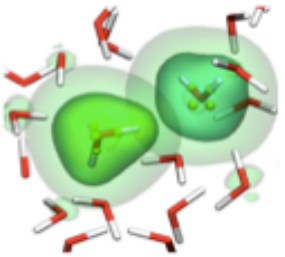
An intrinsic multi-scale approach :

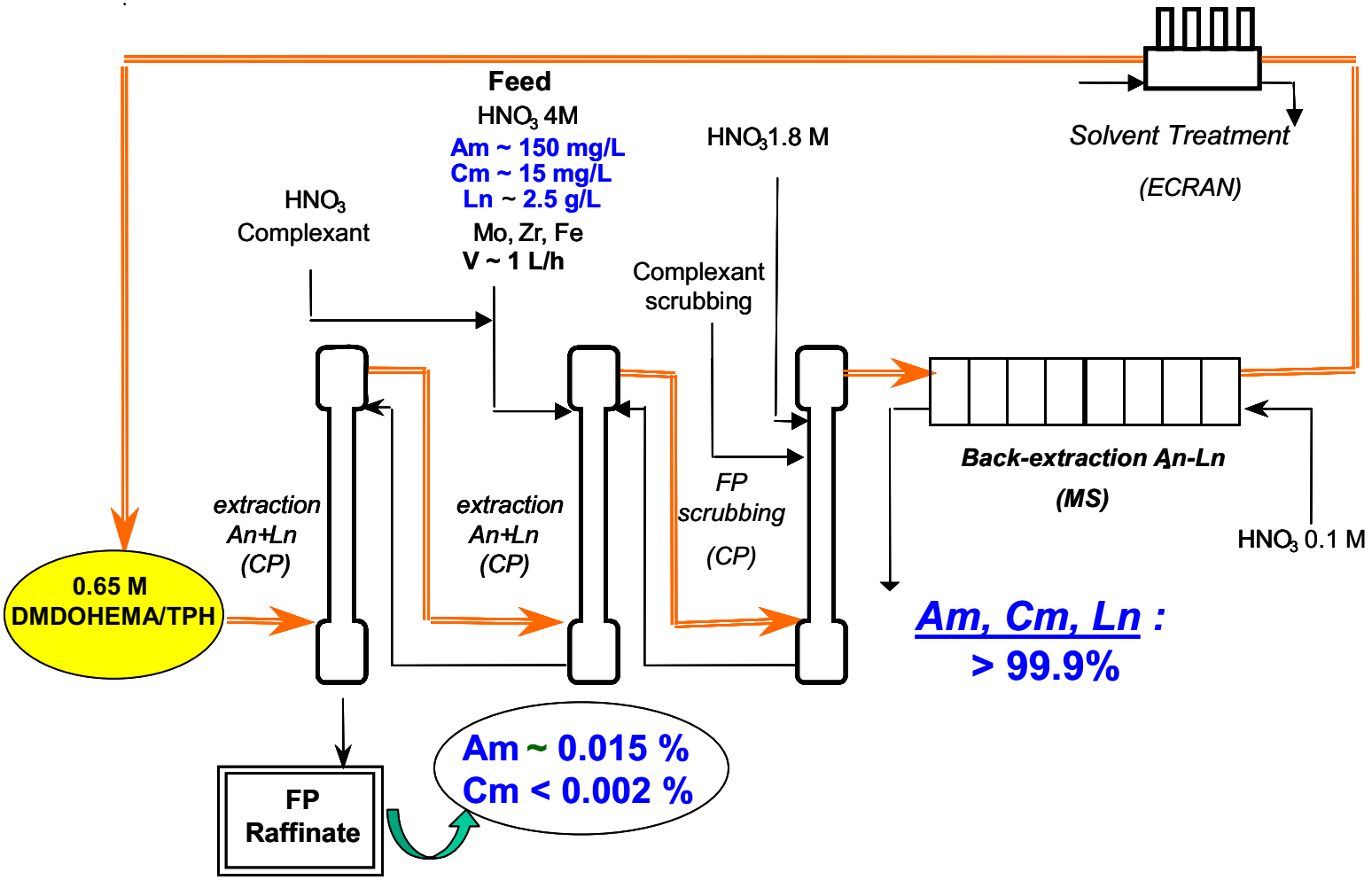








The coupled cascades and solvent treatment



P. Baron et al., , Global 2007

(2 and 3): the ienaic point of view