

SPECIFIC ION EFFECTS ON BUBBLE COALESCENCE INHIBITION IN MIXED ELECTROLYTE SYSTEMS

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All life is thought to depend on liquid water. We argue that all life also requires that a high concentration of electrolyte is dissolved in that water; as at high concentrations of electrolyte the interactions between surfaces becomes complex and depends on the specific nature of the ions present, whereas at low concentrations the interactions are straightforward and not able to support complexity. The effect of electrolytes on surface tension and bubble coalescence in water are experimentally very simple examples of ion-specificity, yet even these very simple systems are not understood.

Single electrolytes inhibit coalescence at moderate concentrations or have no effect, as predicted by ion combining rules based on empirical assignments (α or β)^{1,2}. The mechanism behind electrolyte inhibition, as well as the salt differentiation, is not understood. We here report that mixed electrolytes also follow the ion assignments. In addition, inhibition is consistent with the hypothesis that electrolyte effects depend upon ion separation within the interfacial region and offers support for a recent suggestion by Marčelja³ regarding the origin of the combining rules. We demonstrate that Gibbs elasticity is not the mechanism by which coalescence is inhibited; rather we propose that some electrolyte combinations modify the hydrodynamic boundary condition at the air-water interface resulting in the manifestation of ion-specificity at long-range even at high electrolyte concentrations.

References

- 1 Effect of Electrolytes on Bubble Coalescence
V. S. J. Craig, B. W. Ninham, R. M. Pashley
Nature, **364** (6435), 317-319 (1993)
- 2 The Effect of Electrolytes on Bubble Coalescence in Water
V. S. J. Craig, B. W. Ninham, R. M. Pashley
The Journal of Physical Chemistry, **97**(39), 10192-10197 (1993)
- 3 Selective Coalescence of Bubbles in Simple Electrolytes
Stjepan Marčelja
The Journal of Physical Chemistry B, **110**, 13062-13067(2006)