

## 2. Surface Tension and Viscosity

### Molecular forces

Experiments like rise of liquid in a capillary tube and formation of rain drop into spherical shape show that there exists mutual force between molecules. Such forces are known as molecular forces.

Molecular forces are electrical in nature. The molecular forces arise due to non uniform distribution of charges in the molecule.

Molecular forces are *short range forces*. i.e, molecules can interact only with the closest neighbours. (This is unlike coulomb force  $F$  which is  $F \propto \frac{1}{d^2}$ , which is a long range force)

The greatest distance within which molecules can attract each other is known as molecular range. A sphere drawn with a molecule as centre and molecular range as radius, is known as 'sphere of influence'. A molecule attracts and is attracted by all the molecules, lying within the sphere of influence, while for the molecules outside the sphere of influence the attraction will be inappreciable (negligibly small).

Molecular force between molecules of the same substance are called cohesive force and the force between molecules of different substances is known as adhesive force.

### Molecular interpretation and definition of surface tension

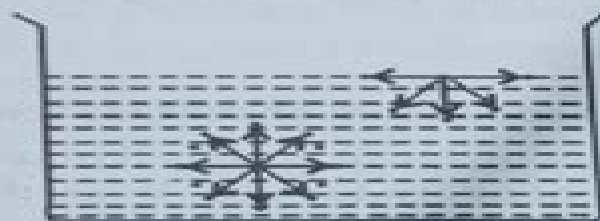


Fig. 20

# Chapter Surface And Intefacial Tension

**Richard Smith Willows, Emil Hatschek**



## **Chapter Surface And Intefacial Tension:**

*Introduction to Applied Colloid and Surface Chemistry* Georgios M. Kontogeorgis, Soren Kiil, 2016-03-28 Colloid and Surface Chemistry is a subject of immense importance and implications both to our everyday life and numerous industrial sectors ranging from coatings and materials to medicine and biotechnology How do detergents really clean Why can't we just use water Why is milk milky Why do we use eggs so often for making sauces Can we deliver drugs in better and controlled ways Coating industries wish to manufacture improved coatings e.g. for providing corrosion resistance which are also environmentally friendly i.e. less based on organic solvents and if possible exclusively on water Food companies want to develop healthy tasty but also long lasting food products which appeal to the environmental authorities and the consumer Detergent and enzyme companies are working to develop improved formulations which clean more persistent stains at lower temperatures and amounts to the benefit of both the environment and our pocket Cosmetics is also big business Creams lotions and other personal care products are really just complex emulsions All of the above can be explained by the principles and methods of colloid and surface chemistry A course on this topic is truly valuable to chemists chemical engineers biologists material and food scientists and many more

**Surfactants** Bob Aveyard, 2019-10-09 Surfactants today you have probably eaten some or rubbed others on your body Plants animals including you and microorganisms make them and many everyday products e.g. detergents cosmetics foodstuffs contain them Surfactant molecules have one part which is soluble in water and another which is not This gives surfactant molecules two valuable properties 1 they adsorb at surfaces e.g. of an oil droplet in water and 2 they stick together aggregate in water The aggregates micelles are able to dissolve materials not soluble in water alone and adsorbed surfactant layers at the surfaces of particles or say oil droplets in water stop the particles or drops sticking together This is why stable emulsions such as milk do not separate into layers This book treats the basic physical chemistry and physics underlying the behaviour of surfactant systems In this book you will first learn about some background material including hydrophobic hydration interfacial tension and capillarity Section I Discussion of surfactant adsorption at liquid fluid and solid liquid interfaces is given in Section II and includes thermodynamics of adsorption dynamic and rheological aspects of liquid interfaces and the direct characterisation of surfactant monolayers In Section III a description is given of surfactant aggregation to give micelles lyotropic liquid crystals microemulsions and Winsor systems There follows a discussion of surface forces and the way they confer stability on lyophobic colloids and thin liquid films Section IV Various dispersions stabilised by adsorbed surfactant or polymer including solid in liquid dispersions emulsions and foams are considered in Section V The wetting of solids and liquids is explored in Section VI Like surfactants small solid particles can adsorb at liquid fluid interfaces form monolayers and stabilise emulsions and foams Such behaviour is covered in Section VII It is assumed the reader has a knowledge of undergraduate physical chemistry particularly chemical thermodynamics and of simple physics Mathematics elementary algebra and calculus is kept at a level consistent with the

straightforward derivation of many of the equations presented

Statistical Thermodynamics Of Surfaces, Interfaces, And Membranes Samuel Safran, 2018-03-08 Understanding the structural and thermodynamic properties of surfaces interfaces and membranes is important for both fundamental and practical reasons Important applications include coatings dispersants encapsulating agents and biological materials Soft materials important in the development of new materials and the basis of many biological systems cannot be designed using trial and error methods due to the multiplicity of components and parameters While these systems can sometimes be analyzed in terms of microscopic mixtures it is often conceptually simpler to regard them as dispersions and to focus on the properties of the internal interfaces found in these systems The basic physics centers on the properties of quasi two dimensional systems embedded in the three dimensional world thus exhibiting phenomena that do not exist in bulk materials This approach is the basis behind the theoretical presentation of Statistical Thermodynamics of Surfaces Interfaces and Membranes The approach adapted allows one to treat the rich diversity of phenomena investigated in the field of soft matter physics including both colloid interface science as well as the materials and macromolecular aspects of biological physics such as interfacial tension the roughening transition wetting interactions between surfaces membrane elasticity and self assembly Presented as a set of lecture notes this book is aimed at physicists physical chemists biological physicists chemical engineers and materials scientists who are interested in the statistical mechanics that underlie the macroscopic thermodynamic properties of surfaces interfaces and membranes This paperback edition contains all the material published in the original hard cover edition as well as additional clarifications and explanations

**Laboratory Manual of Colloid Chemistry** Harry Nicholls Holmes, 1928

Surface Equilibria of Biological and Organic Colloids Pierre Lecomte du Noüy, 1926

**Physical and Chemical Examination of Paints, Varnishes, and Colors** Henry Alfred Gardner, 1922

**Surface Tension and Surface Energy and Their Influence on Chemical Phenomena** Richard Smith Willows, Emil Hatschek, 1919

**Characterization and Properties of Petroleum Fractions** M. R. Riazi, 2005 The last three chapters of this book deal with application of methods presented in previous chapters to estimate various thermodynamic physical and transport properties of petroleum fractions In this chapter various methods for prediction of physical and thermodynamic properties of pure hydrocarbons and their mixtures petroleum fractions crude oils natural gases and reservoir fluids are presented As it was discussed in Chapters 5 and 6 properties of gases may be estimated more accurately than properties of liquids Theoretical methods of Chapters 5 and 6 for estimation of thermophysical properties generally can be applied to both liquids and gases however more accurate properties can be predicted through empirical correlations particularly developed for liquids When these correlations are developed with some theoretical basis they are more accurate and have wider range of applications In this chapter some of these semitheoretical correlations are presented Methods presented in Chapters 5 and 6 can be used to estimate properties such as density enthalpy heat capacity heat of vaporization and vapor pressure Characterization methods of Chapters 2 4 are used to

determine the input parameters needed for various predictive methods One important part of this chapter is prediction of vapor pressure that is needed for vapor liquid equilibrium calculations of Chapter 9     **The Chemical World** ,1912

Fractionation of Fibers in Surfactant Solutions on a Spinning Disk Separator Linda Joanne Johnson,1993

**Transactions of the Institution of Mining & Metallurgy** ,1920     **Industrial and Engineering Chemistry** ,1926

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Emil Hatschek,1916     **Chemistry and Industry Review** ,1929

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## **Table of Contents Chapter Surface And Intefacial Tension**

1. Understanding the eBook Chapter Surface And Intefacial Tension
  - The Rise of Digital Reading Chapter Surface And Intefacial Tension
  - Advantages of eBooks Over Traditional Books
2. Identifying Chapter Surface And Intefacial Tension
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Chapter Surface And Intefacial Tension
  - User-Friendly Interface
4. Exploring eBook Recommendations from Chapter Surface And Intefacial Tension
  - Personalized Recommendations
  - Chapter Surface And Intefacial Tension User Reviews and Ratings
  - Chapter Surface And Intefacial Tension and Bestseller Lists
5. Accessing Chapter Surface And Intefacial Tension Free and Paid eBooks
  - Chapter Surface And Intefacial Tension Public Domain eBooks

- Chapter Surface And Intefacial Tension eBook Subscription Services
- Chapter Surface And Intefacial Tension Budget-Friendly Options
- 6. Navigating Chapter Surface And Intefacial Tension eBook Formats
  - ePub, PDF, MOBI, and More
  - Chapter Surface And Intefacial Tension Compatibility with Devices
  - Chapter Surface And Intefacial Tension Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Chapter Surface And Intefacial Tension
  - Highlighting and Note-Taking Chapter Surface And Intefacial Tension
  - Interactive Elements Chapter Surface And Intefacial Tension
- 8. Staying Engaged with Chapter Surface And Intefacial Tension
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Chapter Surface And Intefacial Tension
- 9. Balancing eBooks and Physical Books Chapter Surface And Intefacial Tension
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Chapter Surface And Intefacial Tension
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Chapter Surface And Intefacial Tension
  - Setting Reading Goals Chapter Surface And Intefacial Tension
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Chapter Surface And Intefacial Tension
  - Fact-Checking eBook Content of Chapter Surface And Intefacial Tension
  - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks

## 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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