Available online at www.derpharmachemica.com

ISSN 0975-413X
CODEN (USA): PCHHAX

Der Pharma Chemica, 2017, 9(13):99-101
(http://www.derpharmachemica.com/archive.html)

Medical Aspects and Role of Van der Waals Forces

Srivastava UC*

Amity Institute of Applied Sciences, Amity University, Noida, Uttar Pradesh, India

ABSTRACT

In the present report the important aspect of weak attraction force between the molecules (van der Walls forces) has been observed and it plays very major role in the formation of complex structures of human bodies. Van der Waals attraction=hydrophobic bond-The weakest of chemical bonds. For molecules which are formed with many nonpolar covalent bonds, these electromagnetic attractions, while individually weak, can produce cumulative forces or keeping the components of cell membrane material in the lipid bilayer configuration. The availability of previous work from different sources is cited in this paper. The purpose of this collective report from different source is to draw attention of researchers and scientists on this weak force in medical aspects which is otherwise ignored in calculation.

Keywords: Van der Waal forces, Hydrophobic forces, Membrane fusion

INTRODUCTION

Prof. Johannes Diderik van der Waals physicist of Dutch has developed the concept of van der waals force. The electrons of each atom shift with respect to the nucleus in the presence of other atoms and consequently an atom becomes an electric dipole. The instantaneous dipole moment of a closed shell atom induces a dipole moment on a similar atom and the interaction energy thus arising is known as the van der Waals interaction, which are anisotropic forces. This is fundamental force for physics, chemistry & biology. However, these are weakest in nature as compared to other chemical interactions or forces. This force is much weaker so it has no importance in our life. The potential of van der Waals forces becomes dominant for components smaller in size. So in development of emerging field of Sciences as well as technology like crystal lattice dynamics, structure analysis, growth of crystals and, nano-robots & micro-machines, the existence and importance of this force has been experienced.

THEORY

In the present communication, the author has reported the importance of van der Waals forces by using some reported data. The author has presented analysis of this force in medical aspects. To study the biological importance of van-der-Waals force, a sophisticated experimental setup has been designed by Lonij–Holmgren et al. that measures the interactions between single atoms and a surface. From de-Broglie hypothesis the atoms play dual characteristics in term of particles and waves [1]. Due to the adhesive nature when the intense light beams strikes atoms through the metal surface some atoms adhesive with nearer the metals surface. We can observe very fast fluctuation because the electron and positron are present inside atom and move randomly such that the position changes rapidly. So very small differences in charge can be noticed. Now achieving this condition, any charge behaves like image charge near the surface, and atom is attracted to its image charge. So frame surface presence of bunches of –ve and +ve charges of atoms, generate weak forces having the nature and property of van-der-Waals force. The electromagnetic vibrations produce molecular and electron clouds interactions & their nature of attractions may depend on the vibrational frequencies range. In the presence of strong Van der Waal interaction trajectory motion of atom changes. This changing strength is measured as change in phase of potential of matter wave. The nature of van-der-Waals forces is to stick to anything and form any type of structure. Due to its weak nature its action range exists in atomic scale only so it is often ignored by us in experiments and in day to-day life. Our body structure is made of proteins and only in presence of Van der Waals forces the complex structures of human bodies can become possible which gives us strength for different work. The following fact has been published by different scientists which has validated the important of Van der Waals forces. When two thin polar membranes made of two layers of liquid molecules approach each other, they experience weak van der Waals attractive forces and much stronger repulsive forces due to hydration repulsion [2]. The formation of hydration repulsion represented in Figure 1a and 1b.

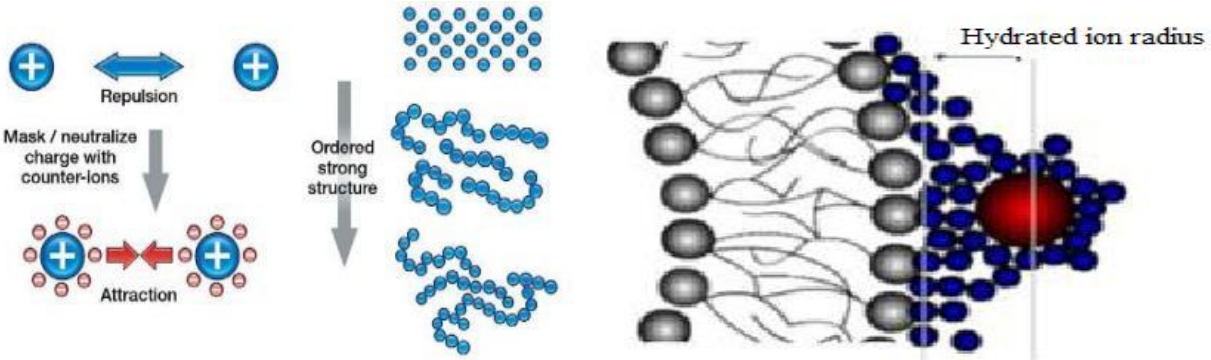

Figure 1: (a and b) Hydration repulsion

These forces are normally dominant over the hydrophobic attractive forces (physical property of a molecule that is repelled from a mass of water) between the membranes. Studies done on membrane bilayers using surface forces apparatus indicate that membrane fusion can instantaneously occur when two bilayers are still at a finite distance from each other without them having to overcome the short-range repulsive force barrier [3].

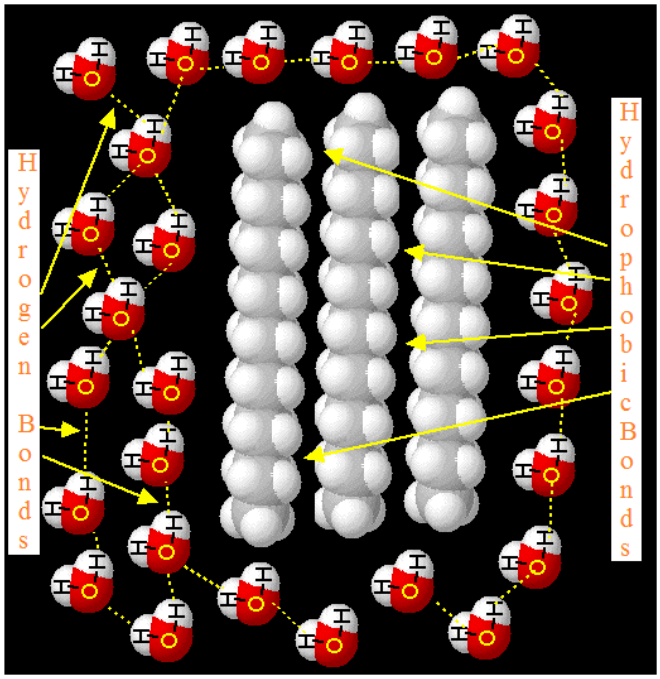

Figure 2: Hydrophobic bond

In Figure 2 attributed to the molecular rearrangements that occur resulting in the by- passing of these forces by the membranes. This results in very strong hydrophobic attractions (which dominate the repulsive force) between the exposed groups leading to membrane fusion [4]. The attractive van der Waals forces play a negligible role in membrane fusion. Thus, fusion is a result of the hydrophobic attractions between internal hydrocarbon chain groups that are exposed to the normally inaccessible aqueous environment. Fusion is observed to start at points on the membranes where the membrane stresses are either the weakest or the strongest. Inter bilayer forces play a key role in mediating membrane fusion, which has extremely important biomedical applications [5-8].

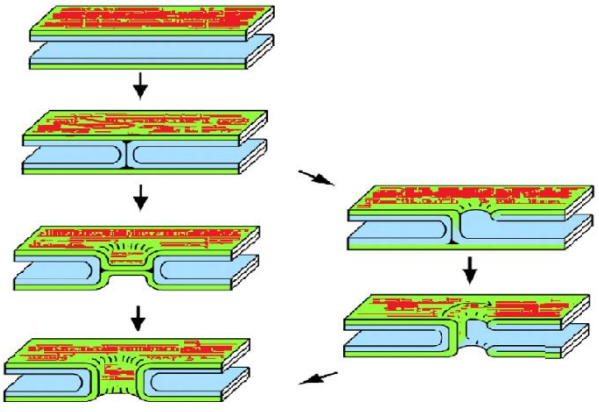

Figure 3: Membrane fusion

Membrane fusion in Figure 3 [9] also has a major role in cancer immunotherapy. Currently, one of the approaches in cancer immunotherapy involves vaccination of dendritic cells which express a specific tumor antigen on their membranes. Instead, the hybrid cells obtained from the fusion of dendritic cells with tumor cells can be used. These hybrids would help in the expression of a range of tumor-associated antigens on their membranes [5]. Already the importance of such forces has been widely reported [10-15]; and phonon study of alkali halides & ionic crystal structure, semiconducting materials and in noble metals.

RESULTS

To sum up, the knowledge of van der Waals forces was is essential to study various phenomena. But use of such forces in medical purposes has provided a broad future prospective for young researcher. So the understanding of van der Waals forces is essential in study of formation of body structure various physical, chemical and biological phenomenon's. On the basis of reported experimental result [1-5] this gives motivation for further study it apply for advanced Medical research and help in the cure of critical diseases.

CONCLUSION

The Author has motivated to present work due to the availability of the theoretical model and experimental work on van der Waals forces [1-3,10-13]. Therefore, it may be inferred that the inclusion of van der Waals interaction is very essential for the study of human body also. This provides a new tool for observation and remedy for critical diseases. The only limitation of that proposed tools that it is a collaborative work so without both medical and theoretical researcher future of the advance work not possible. In view of its adequacies, the present model may be understood to provide as a powerful and simple approach for study of critical dieses in medical aspect. The only limitation of the model is the requirement of knowledge of certain Bio-experimental information to be used as input data.

REFERENCES

[1] L. Holmgren, *Phy. Rev. Lett.*, **2010**, 105(23), 10.1103.
[2] Israelachvili, *Quart. Rev. Biophys*., **2001**, 34, 2, 105
[3] Israelachvili, *Sci.*, **1989**, 246, 4932
[4] Hen, *Science*., **2005**, 308, 369.
[5] Leikin, *J. Theoret. Biol*., **1987**, 129, 411.
[6] Zeta Potential and Shape of Particles by Malvern Instruments Enigma Business Park, Malvern Worcestershire, WR14 1XZ, UK.
[7] Z. Wu, Q. Ping, Y. Wei, J. Lai, *Acta. Pharmacol. Sci.*, **2004**.
[8] F. James Thompson, *Web Resources for Human*, **2010**.
[9] Engel, *The Rockefeller University Press*, Published JCB, **2008**, 181-186.
[10] A.D.B Woods, W. Cochran, B.N. Brockhouse, *Phys. Rev.*, **1960**, 119, 980.
[11] M.P. Verma, R.K. Singh, *Phys. Stat. Sol*., 33, **1969**, 769.
[12] U.C. Srivastava, Ph.D. thesis, **2004**.
[13] U.C. Srivastava, *Arch. Phys*., **2011**, 2(2), 9-26.
[14] U.C. Srivastava, *Opt. elect. Adv. Mat*., *Rapid Commun.* (OAM-RC), **2013**, 7, 9-10.
[15] U.C. Srivastava, K.S. Upadhyaya, *Arch. Appl. Sci. Res*., **2015**, 7(10), 25-31.