International Conference on

WATER, HYDROGEN BONDING NANOMATERIALS AND NANOMEDICINE

水, 氢結合納米材料, 納米醫學

Вода, наноматеријали на бази водоничних веза, наномедицина

organized by

Academy of Sciences and Arts of the Republic of Srpska

and

NanoLab, Faculty of Mechanical Engineering, University of Belgrade, Serbia

under the auspices of

Ministry of Health and Social Welfare of the Republic of Srpska

Ministry of Science and Technology of the Republic of Srpska

The Republic of Srpska Medical Association

Water the Creator

September 4, 2010, Cultural Centre Banski dvor

Banja Luka, Republic of Srpska
Bosnia and Herzegovina

PROGRAMME

and

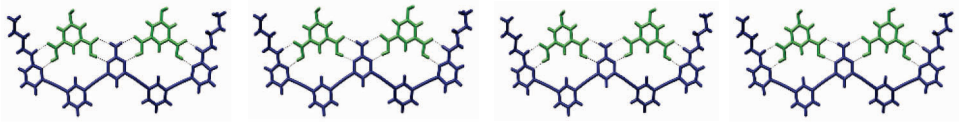
THE BOOK OF ABSTRACTS

Water, Hydrogen Bonding Nanomaterials, Nanomedicine

水, 氢結合納米材料, 納米醫學

Вода, наноматеријали на бази водоничних веза, наномедицина

Conference Secretary
Aleksandra Bajić
medj.saradnja@anurs.org
anurs@blic.net
www.anurs.org



International Conference on
Water, Hydrogen Bonding Nanomaterials, Nanomedicine
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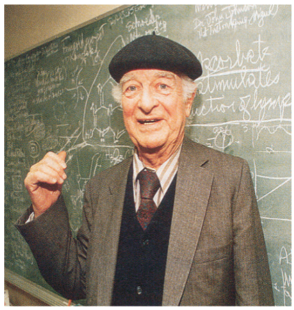
INTRODUCTION


Thales of Miletus (624 – 546 BC)

It is reported that Thales predicted an eclipse of the Sun on May 28, 585 BC. In that time it was equal challenge as today prediction of experiments by Large Hadron Collider (LHC) in Geneve. Also, he believed that *water constituted the principle of all things.* If so, than water is not only important for biological life, but in general for understanding matter. How it can make sense? In modern science we believe that hydrogen (and helium) is formed as general cosmic processes, while oxygen is result of local cosmic activity in stars. Relation between *whole* and *part*, or *general* and *local*, base on the best harmony (the golden mean properties) are present in water molecule. Even more water, as set of water molecules interconnected by hydrogen bonds, satisfied the law of *large numbers*, what lead us to statistical mechanics, entropy and information theory.

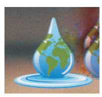
GOAL OF THE CONFERENCE


Linus Pauling (1901-1994)

The primary goal of the WHBM&NM Conference is devoted to a broad international forum on the nature of hydrogen bond, science and technology of hydrogen bonding materials and devices. Particular accent will be put on both theoretical and experimental approaches of ordinary, clusters and crystalline water, DNA hydrogen bonding, proteins, metals and other materials. Special attention will be given to role and importance of hydrogen bonds in bulk and nano-structured materials, molecular recognition and water properties and behavior in biology and devices. One of the best expression about importance of hydrogen bonds for system functionality is given by Linus Pauling, who wrote seventy years ago "I believe that as the methods of structural chemistry are further applied to physiological problems, it will be found that the significance of the *hydrogen bond* for physiology is greater than that of any other single structural feature".

水水

納米科學，納米技術，納米醫學



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Friday, September 3, 2010

* Arrival of the participants and accommodation in the hotel „Bosna"
* Early registration
* Dinner (restaurant of the hotel „Bosna")

Saturday, September 4, 2010
Cultural Centre Banski dvor

8:30 – 10:00 REGISTRATION

10:00-10:15 OPENING CEREMONY

Rajko Kuzmanović, President of the Republic of Srpska and President of the Academy of Sciences and Arts of the Republic of Srpska
INTRODUCTION AND WELCOME

ORAL PRESENTATIONS

10:15-11:45
Gerald Pollack, USA
WATER, ENERGY AND LIFE: FRESH VIEWS FROM THE WATER'S EDGE

11:45-12:00 *Coffee break*

12:00- 12:30
Mae-Wan Ho, UK
LIQUID CRYSTALLINE WATER & THE LIVING STATE

12:30-13:00
Arieh Ben-Naim, Israel
HYDROPHOBIC-HYDROPHILIC INTERACTIONS IN PROTEIN FOLDING, PROTEIN-PROTEIN ASSOCIATION AND MOLECULAR RECOGNITION

13:00-15.00 *Lunch*

15:00-15:30
Roumiana Tsenkova, Japan
AQUAPHOTOMICS: MONITORING OF WATER – LIGHT INTERACTION FOR BETTER UNDERSTANDING OF BIOLOGICAL WORLD

15:30-16:00
Myron Evans, Douglas Lindstrom, Horst Eckardt, Canada
ECE THEORY OF HYDROGEN BONDING

16:00-16:25
Đuro Koruga, Serbia
PARAMAGNETIC/DIAMAGNETIC PROPERTIES OF WATER AND AQUEOUS SOLUTIONS: CLASSICAL/QUANTUM APPROACH FOR BIOMEDICAL APPLICATIONS

16:25-16:35 *Coffee break*

16:35-17:05
Milan Jokanović, Republic of Srpska, B&H
THE EFFECT OF WATER EXPOSED TO PULSED ELECTROMAGNETIC IRRADIATION ON BIOLOGICAL SYSTEMS IN VITRO

17:05-17:30
Lidija Matija, Milena Papić-Obradović, Serbia
HYDROGEN BONDING NANOSTRUCTURES FOR NANOMEDICINE

17:30-17:50
Đorđe Kozić, Serbia
WATER – FROM UNIQUE PROPERTIES SUSTAINING LIFE TO INSPIRATION OF ARTISTS

18:00-19:30 POSTER PRESENTATIONS

Dragoljub Lj. Mirjanić, Ana J. Šetrajčić-Tomić, Jovan P. Šetrajčić, Republic of Srpska, B&H and Serbia
SHELL-NANOSTRUCTURED MATERIALS FOR BIOPHARMACY AND BIOMEDICINE

Milena Papić-Obradović, Serbia
WATER IN HUMAN EMBRYOGENESIS AND AGING

Suzana Miljković, Dušan Kojić, Lidija Matija, Jadran Bandić, Goran Janjić, Serbia
WATER NANO-LAYERS IN HUMAN SKIN

Goran Janjić, Serbia
ETRACELLULAR/INTACELLULAR AND FREE/CAPTURE WATER IN HUMAN ORGANISM

Čeda Lalović, Dušan Kojić, Spomenko Mihajlović, Serbia
WATER HYDROGEN BONDS AND GOLDEN RATIO OF 1.618

Zorana Golubović, Serbia
THE RETENTION OF WATERBORN ORGANIC MOLECULE WITH NANOFILTRATION

Dušan Kojić, Aleksandar Tomić, Čedomir Lalović, Đuro Koruga, Serbia
WATER CHARACTERIZATION BY OPTO-MAGNETIC FINGERPRINT

Aleksandar Tomić, Lidija Matija, Zorana Golubović, Željko Ratkaj, Đuro Koruga, Serbia
CELLULAR AND INTRACELLULAR HYDROGEN BONDS AND PROTON TRANSPORT BY MICROTUBULES

Jelena Munćan, Đuro Koruga, Serbia
WATER IN HUMAN BRAIN: NANOTECHNOLOGY APPROACH FOR ALZHEIMER'S DISEASE

Zoran Vosika, Jovana Simić-Krstić, Goran Janjić, Zoran Mitrović, Serbia
ON USING BIOIMPEDANCE AND FRACTIONAL CALCULUS FOR SKIN HYDRATION ASSESSMENT

Nikola Jagodić, Dragomir Stamenković, Božica Bojović, Nevena Stevanović, Serbia
CONTACT LENSES RAFNESS AND WATER NANOLAYERS FUNCTIONALITY

Dragomir Stamenković, Nikola Jagodić, Manuel Conte, Đuro Koruga, Serbia
NANOPHOTONIC CONTACT LENSES BASED ON HYDROGEN BONDING MATERIAL

Jovan Vojinović, Vladan Mirjanić, Slobodan Čupić, Republic of Srpska, B&H
BOND STRENGTH OF NANOSTRUCTURE ADHESIVE MATERIALS FOR THE SURFACE OF TOOTH ENAMEL FORMING IN AQUEOUS ENVIRONMENT

Slobodan Čupić, Vladan Mirjanić, Jovan Vojinović, Republic of Srpska, B&H
COMPARATIVE ANALYSIS OF BOND STRENGTH OF COMPOSITE MATERIALS TO TOOTH SURFACE WITH MATERIALS THAT REACT IN AQUEOUS ENVIRONMENT

19:30-19:45 CONCLUSIONS

19:45-20:00 CLOSING CEREMONY

20:00-23:00 *Dinner*

Sunday, September 5, 2010

9:00 Trip by bus to Herceg Novi, Montenegro

19:00 Accommodation at the hotels in Herceg Novi, Montenegro

Monday, September 6, 2010

YUCOMAT – 2010

Tuesday, September 7, 2010

10:00-12:30
HOTEL PLAŽA, Press Conference Room

ROUND TABLE
Water, Hydrogen Bonding Nanomaterials and Nanomedicine

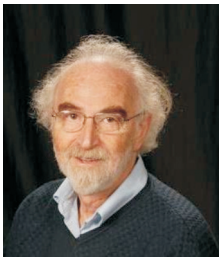
Chairmen: *Gerald Pollack, Milena Papić-Obradović*
Organizing Committee: *Đuro Koruga, Mae-Wan Ho, Dragoljub Mirjanić, Zorana Golubović, Jelena Munćan*
Secretary: *Aleksandra Bajić*

Plenary lecture:
Gerald Pollack, USA
WATER, ENERGY AND LIFE

Introduction lecture:
Milena Papić-Obradović, Suzana Miljković, Đuro Koruga
BASIS OF NANOMEDICINE: Embryology, Pharmacology, Nanotechnology

Discussion

A b s t r a c t s



Gerald H. Pollack
Department of Bioengineering
University of Washington
Seattle WA 98195 USA

WATER, ENERGY AND LIFE: FRESH VIEWS FROM THE WATER'S EDGE

The impact of surfaces on the contiguous aqueous phase is generally thought to extend no more than a few water-molecule layers. We find, however, that colloidal and molecular solutes are profoundly excluded from the vicinity of hydrophilic surfaces, to distances typically up to several hundred micrometers. Such large zones of exclusion have been observed next to many different hydrophilic surfaces, and many diverse solutes are excluded. Hence, the long-range exclusion phenomenon appears to be a general feature. It is present next to biological and artificial surfaces as well as next to nanostructures.
To test whether the physical properties of the exclusion zone differ from those of bulk water, several methods have been applied. NMR, infrared, and birefringence imaging, as well as measurements of electrical potential, viscosity, and UV-VIS and infrared-absorption spectra, collectively reveal that the solute-free zone is a physically distinct, more ordered phase of water. It is also charged. It can co-exist essentially indefinitely with the contiguous solute-containing phase. Indeed, this unexpectedly extensive zone may be a candidate for the long-postulated "fourth phase" of water.

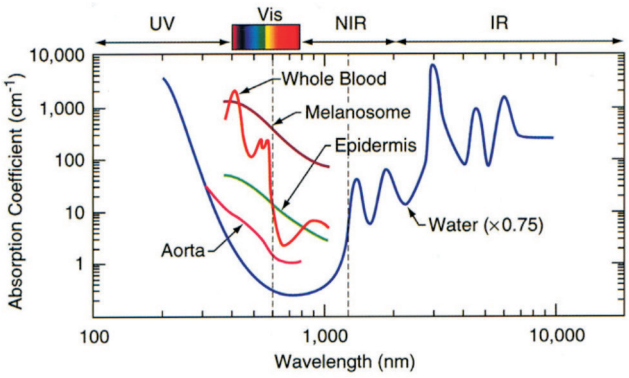


Fig.1 Water absorption spectra at 3 m peak as an exclusive zone

The energy responsible for building this charged, low entropy zone comes from light. We found that incident radiant energy including all visible and near-infrared wavelengths induce exclusion-zone growth in a spectrally sensitive manner. IR is particularly effective. Five-minute exposure to low-intensity radiation at 3-μm wavelength induces an exclusion-zone-width increase up to three times. Apparently incident photons cause some change in

bulk water that predisposes constituent molecules to reorganize and build the charged, ordered exclusion zone.

Photons from ordinary sunlight, then, may have an unexpectedly powerful effect that goes beyond mere heating. Solar energy apparently builds order and separates charge between the near-surface exclusion zone and the bulk water beyond - the separation effectively creating a battery from which current can be drawn. This light-induced action (resembling the first steps of photosynthesis) would seem relevant for realms of nature and engineering involving water and interfaces, and also for biology, where much of the cell's water may be of this variety. The implications are amply discussed in http://uwtv.org/programs/displayevent.aspx?rID=22222 and will be presented.

References:

[1] Zheng, J.M. and Pollack, G. H.: Long range forces extending from polymer surfaces. Phys Rev E.: 68: 031408, 2003

[2] Zheng, J.-M., Chin, W. -C, Khijniak, E., Khijniak, E., Jr., Pollack, G. H. Surfaces and Interfacial Water Water:Evidence that hydrophilic surfaces have long-range impact. Adv. Coll Interf. Sci. 127:19-27, 2006

[3] Chai, B, Yoo, H. and Pollack, GH: Effect of Radiant Energy on Near-Surface Water. J. Phys. Chem. B 2009, 113,13953-13958

Mae-Wan Ho
Institute of Science in Society
29 Tytherton Road,
London N19 4PZ, UK

LIQUID CRYSTALLINE WATER & THE LIVING STATE

The remarkable properties of protoplasm, the stuff of living cells and organisms, have been noted since the beginning of the 19th century. Soon afterwards, water was recognized as a 'bound' constituent of protoplasm and the unusual properties of such 'bound' biological water became the focus of enquiry. However, it was not until Gilbert Ling's Association-Induction (AI) hypothesis (Ling, 1962,1984) that the pivotal role of water in living organization became explicitly defined. The AI hypothesis proposes that the major components of living protoplasm - water, proteins, and K+ - exist in a closely associated, high-energy state.

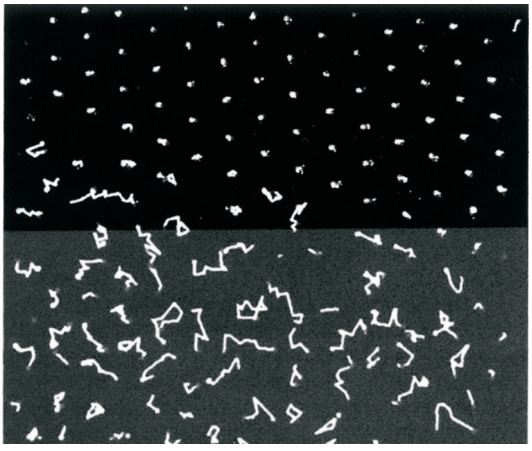


Fig.1 Order difference during one second between two water types in motion: crystalline water (top) and disordered water (bottom).

In my laboratory, we discovered that living cells and organisms are highly coherent, dynamic, liquid crystalline phases; and furthermore, the large amounts of associated water, both within the cells and in the extracellular matrix, are an integral part of the organisms' liquid crystalline living state (Ho, 1993,1998,2008; Ho et al, 2006).
There has been a great deal of progress in water research within the past decade. I shall review some key findings in support of a theory of the living state in which liquid crystalline water plays the leading role.

References:

[1] Ho MW. The Rainbow and the Worm, the Physics of Organisms, World Scientific, 1993, 1998 (2nd ed), 2008 (3rd ed), World Scientific, Singapore & London.
[2] Ho MW, Zhou Y-M, Haffegee J, Watton A, Musumeci F, Privitera G, Scordino A and Triglia A. The liquid crystalline organism and biological water. In Water in Cell Biology (G. Pollack ed.), Springer, Dordrecht 2006. http://www.i-sis.org.uk/ onlinestore/papers.php
[3] Ling G. A Physical Theory of the Living State: The Association-Induction Hypothesis, Blaisdel, Waltham, Massachusetts, 1962.
[4] Ling G. In Search of the Physical Basis of Life, Plenum Press, New York, 1984.

Arieh Ben-Naim
Department of Physical Chemistry
The Hebrew University of Jerusalem
Jerusalem, 91904, Israel

HYDROPHOBIC-HYDROPHILIC INTERACTIONS IN PROTEIN FOLDING, PROTEIN-PROTEIN ASSOCIATION AND MOLECULAR RECOGNITION

Many biochemical processes such as protein folding or self assembly of proteins are highly specific. Proteins fold spontaneously into a very specific 3-dimensional structure. Proteins also associate spontaneously to form multi-subunit macromolecules. These processes occur in aqueous media. The question we pose is what is the role of water in these processes?
Until recently it was believed that the hydrophobic effect, i.e. the tendency of hydrophobic groups to "escape" from the aqueous environment is the dominant driving force for these processes.

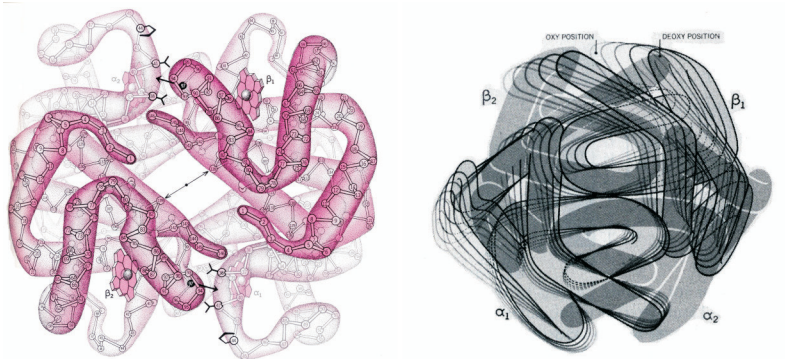


Fig.1: Protein folding and protein interaction of four hemoglobin tetramers (left), and their motion during shifts from deoxy-to oxyhrmoglobin (right)

Analysis of all the solvent induced contributions to the thermodynamic driving forces for protein folding and protein-protein association reveals that, contrary to the commonly accepted paradigm, hydrophilic interactions might be more important than hydrophobic interactions.2
This conclusion was reached after critically examining the data on the various contributions to the driving forces for protein folding, and protein-protein association. Examples on the role of hydrophilic interactions on solubility of proteins, protein folding, protein-protein association and molecular recognition will be presented. Thus, hydrophilic interactions not only helps in understanding the role of water in biochemical processes, but they can also be applies to design drugs that bind stronger to their targets.3,4

References:

[1] W. Kauzmann, Advances Protein Chemistry 14,1 (1959)
[2] A. Ben-Naim, Biopolymers, 29, 567 (1990)
[3] A. Ben-Naim, Molecular Theory of Water and Aqueous Solutions, Part I: Understanding Water, World Scientific, Singapore (2009)
[4] A. Ben-Naim, Molecular Theory of Water and Aqueous Solutions, Part II: The Role of Water in Biological Systems, World Scientific, Singapore (to be published 2011)

Roumiana Tsenkova
Kobe University
1-1 Rokkodai Nada Kobe
Kobe, Japan 657

AQUAPHOTOMICS: MONITORING OF WATER - LIGHT INTERACTION FOR BETTER UNDERSTANDING OF BIOLOGICAL WORLD

Water is a complex system that defines the complexity and functionalities of biological systems, respectively1,2. It has been studied with different tools and methods over the years. Finding an approach for dynamic non-destructive analysis of water hydrogen bonding in biological systems would elucidate the relation between biological functions and the water structure.

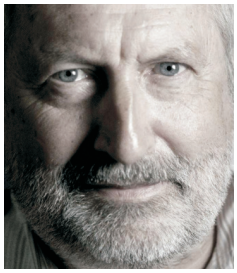
The variability and high water content in biological world does not allow easy monitoring and analysis under perturbations. In these regards, water - light interaction pattern presented as an electromagnetic spectrum of light absorbance could be used as an enormous source of information: physical and chemical3. Water absorbance bands and overtones, in general, have been identified4, but there are still numerous hydrogen absorbance bands related to the water molecular system that need to be identified and further used for understanding of biology.

Fig.1: AquaPhotomics: Near infrared light and water interaction reveals peculiarities of biological systems

In order to describe water from a system point of view, aquaphotomics has been introduced as a new approach to study water molecular system in biology3. Aquaphotomics is based on visible-near infrared spectroscopy (VIS - NIRS) and multivariate analysis. It discovers new water hydrogen bonds in biological systems under various perturbations and relates water absorbance patterns to respective biofunctionalities. Once these data base of water absorbance bands, i.e. water matrix coordinates, WAMACS, called aquaphotome has been built up, various characteristic water absorbance patterns, i.e. water molecular structures would be discovered. Examples of biodiagnosis and the respective water absorbance patterns will be presented. Together with other “omics” sciences, aquaphotomics would lead to complete understanding of water as a life matrix.

References:

[1] R. Roy, W.A. Tiller, I. Bell and M.R. Hoover, The structure of liquid water; novel insights from materials research; potential relevance to homeopathy, Mat. Res. Innovat. 9(4), 93-124, 2005.
[2] J.L. Finney, The water molecule and its interactions: the interaction between theory, modelling, and experiment, J. Mol. Liquids. 90(1-3), 303-312, 2001.
[3] R. Tsenkova, Aquaphotomics: dynamic spectroscopy of aqueous and biological systems describes peculiarities of water, J. Near Infrared Spectrosc. 17, 303-314, 2009.
[4] M. Chaplin, Water structure and science: http://www1.lsbu.ac.uk/water/vibrat.html#d



Myron W. Evans
British Civil List
(www.aias.us)

Douglas Lindstrom and ***Horst Eckardt***
Alpha Institute for Advanced Study (AIAS), Canada

ECE THEORY OF HYDROGEN BONDING

Introduction
The Einstein Cartan Evans (ECE) unified field theory (www.aias.us) has been developed in 145 source papers to date and is accepted as the first successful unified field theory. All the equations of physics and chemistry may be derived from it, notably the Schroedinger equation and the Coulomb law used in that equation. The incorporation of the spin connection of general relativity has given rise to the possibility of spin connection resonance in computational chemistry (for example paper 63 of the ECE series (UFTJ63)).

Problem Identification and Goals
The problem is to develop quantum chemistry packages to include the ubiquitous spin connection in the Coulomb law of the Schroedinger equation. This requires development of density functional code or other types of code to model intermolecular potentials. In water for example the H bonding is of fundamental importance, and the intermolecular potential must be able to describe the properties of water. The presence of spin connection resonance may change these properties in a useful way.

Problem Solutions
The spin connection of general relativity is modelled and incorporated in the Coulomb law as in UFT 63 and similar papers on www.aias.us. The modelled spin connection is incorporated in computational quantum chemistry using methods such as density functional code. Finally the code is used to build up the intermolecular potential for water and used in molecular dynamics and MonteCarlo/imulations.

Conclusion
The major contribution to physics is that all its equations of motion are understood with the simplest possible geometry, eliminating excessive abstraction and unifying the subject of field theory. Therefore the Schroedinger equation and the Coulomb law are derived from geometry within the same methodology.

References:

[1] M. W. Evans, "Generally Covariant Unified Field Theory" (Abramis 2005 to present), in seven volumes to date (www.aias.us, www.atomicprecision.com, www.upitec.org). The 145 source ECE papers on the websites of reference (1).
[2] M. W. Evans and H. Eckardt, UFT 63 on www.aias.us

Đuro Koruga
NanoLab, Department of Biomedical Engineering
Faculty of Mechanical Engineering,
University of Belgrade
Kraljice Marije 16, 11120 Belgrade, Serbia

PARAMAGNETIC/DIAMAGNETIC PROPERTIES OF WATER AND AQUEOUS SOLUTIONS: CLASSICAL/QUANTUM APPROACH FOR BIOMEDICAL APPLICATIONS

Until 1999, hydrogen bonds have been considering from classical physics (Coulomb interaction), when was experimentally shown that hydrogen bond possess quantum mechanical properties (Isaack, 1999). Bearing in mind that water is one of the richest hydrogen bonding structures, and it makes 65% of human body indicate how much is important investigation of biological systems from both classical and quantum approaches. However, link between classical mechanics (Galileo/Newton) and quantum mechanics (Planck/Schrödinger/Heisenberg) has not been solving in satisfactory way yet (Penrose, 2000). Our goal was to solve this problem using light-matter interaction based on electrical and magnetic forces of covalent bonds and intermolecular (hydrogen) bonds. DNA research indicates that both classical and quantum mechanical approach give same phenomenological results for those structures. Planck constant (h) was the first criteria to estimate whether an object is classical or quantum. Since Planck constant by nature is action than product of force (F), distance (d) and time (t) of action have to has value h (6.626 V10-34 Js), or close enough, if system is quantum one. However, answer what will be value of action for coupling quantum-classical system, or when classical one becomes dominant is find out in ratio of electrical and magnetic forces of considered matter (Koruga, et al 2006).

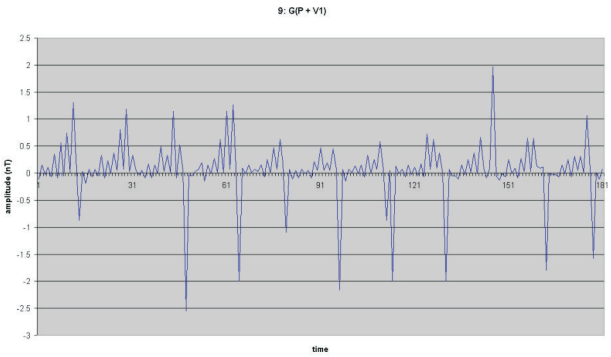


Fig.1: Paramagnetic/diamagnetic properties of tap water

Light-water interaction, based on electrical and magnetic forces, open a new view of classical/quantum properties of hydrogen bonds, and their rule in DNA-water and protein-water interactions. Also, it is experimentally shown than ratio of paramagnetic/diamagnetic

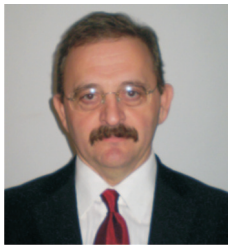
value (about 5nT) of water depends of electrical and magnetic forces of water clusters, during their assembly/disassembly. This can be important for biomedical application in generally, and nanomedical application, particularly.

References:

[1] Isaack, E. D., Shukla, A., Platzman, P. M., Hamann, D. R., Barbililini, B. and Tulk, C., Covalency of the Hydrogen Bond in Ice: A Direct X-Ray Measurement, Physical Review Letters, 82(3),600-603,1999

[2] Penrose, R., The Large the Small and the Human Mind Cambridge University Press (Canto edition) Cambridge, 2000.

[3] Koruga, D., Tomic, A., Ratkaj, Z., Matija, L. Classical and Quantum Information Channels in Protein Chain, Mat Sci For, 518, 491-497, 2006.



Milan Jokanović
Faculty of Medicine,
University of Banja Luka
Republic of Srpska, B&H

THE EFFECT OF WATER EXPOSED TO PULSED ELECTROMAGNETIC IRRADIATION ON BIOLOGICAL SYSTEMS IN VITRO

In this study the effect of exposure of tap water to pulsed electromagnetic irradiation on biological systems in vitro. Exposure to pulsed electromagnetic irradiation was performed according to patented technology of A. Nikolaou (patents WO 01/26493, EP 1092354, US 2004/0206366A1 and AU2933700 named „Method for the qualitative improvement of the products of tobacco plant“) during 24 hours. Technology is based on emision of pulsed electromagnetic irradiation of low power (10-7W) and wide frequency range (30-300 Hz). Deionized water not exposed to the electromagnetic irradiation served as control. Biological systems tested in this study were C6 rat glioma cells, MCF7 human mammary carcinoma cells, normal rat red blood cells and lymphocytes. Solutions and mediums in which the cells were maintained were prepared in tap water exposed to pulsed electromagnetic irradiation or in deionized water (control). Parameters assessed were morphological characteristics of the cells, cell proliferation (according to the method of Neutral Red Uptake) and cell viability (according to the Trypan blue exclusion test which stains only cells having damaged membranes).
The results obtained did not reveal any differences in maintenance of normal cells such as red blood cells and lymphocytes in mediums that were prepared in exposed tap water or in deionized water. There were no differences in morphological characteristics of tested cells. Viability of C6 and MCF7 cells was similar in both types of water. However, cancer cells (C6 and MCF7), that were maintained in mediums prepared in tap water exposed to pulsed electromagnetic irradiation had shown significantly decreased proliferation compared to control. At present I cannot explain the mechanism of this effect, but it is possible that pulsed electromagnetic irradiation have caused certain changes in molecular water structure which could influence the decreased rate of cancer cells multiplication.

References:

[1] M. Jokanović, M. Prostran - Pyridinium oximes as cholinesterase reactivators. Structure-activity relationship and efficacy in the treatment of poisoning with organophosphorus compounds. CURRENT MEDICINAL CHEMISTRY 16, 17, 2177-2188, 2009.
[2] M. Jokanović – Current understanding of the mechanisms involved in metabolic detoxication of warfare nerve agents. TOXICOLOGY LETTERS 188, 1-10, 2009.
[3] V. Piperski, M. Vračar, M. Jokanović, P. Stukalov, Lj. Rakić - Detection of apoptosis and phagocytosis in vitro in C6 rat glioma cells treated with tiazofurin. APOPTOSIS 3, 345-352, 1998.

Lidija Matija
NanoLab, Faculty of Mechanical Engineering
University of Belgrade
Kraljice Marije 16,11120 Belgrade, Serbia

Milena Papić-Obradović
Clinic of Gynecology and Obstetrics-Narodni front
Kraljice Natalije 62,11000 Belgrade, Serbia

HYDROGEN BONDING NANOSTRUCTURES FOR NANOMEDICINE

Water is one of five key structures (DNA, proteins, lipids and minerals) for life existence. Total body water is around 60% of human body weight, while average value of intracellular water is 40% and extracellular is 20%. Water, DNA and proteins are the richest own hydrogen bonding biomolecules. In case natural hydrogen bond of biomolecule is destroyed or become weakening, conformation state of molecule is changed. Usually, conformation change violate molecular functionality, like protein folding or mechanism of the deoxyhemoglobin (T state) to oxyhemoglobin (R state) transition in hemoglobin. Since all biomolecules are dissolved in water (fluid solution) problem could be solved if hydrogen bonds of water around unfunctional biomolecule oscillate by law which has biomolecule in natural state. It is well known that three very important biomolecules DNA, microtubules and collagen are structured by golden mean law (Rakocevic, 1998, Matija et al, 2004). They are natural biological nano-coding materials. Structured nanomaterials are different than nanoparticules. Nanomaterials is self-organized structures by 0D and 1D (zero-, and one-dimensional space) symmetry, and semi-nanomaterial with 2D symmetry property, while nanoparticules are 3D chop up materials on nano scale. Molecule C60 is one of the first nano-material discovered in 1985 by Kroto, Smalley and Curl having golden mean properties (Kroto et al, 1985).

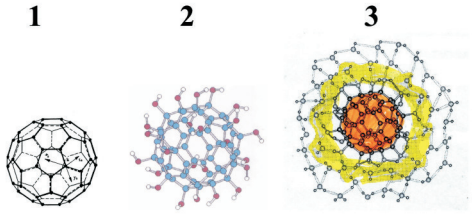


Fig.1: Molecule C_{60} (*left*), hydrogen bonded $C_{60}(OH)_x$ nanostructure (*middle*) and energetically stabilized nano harmonized supstnce $C_{60}(OH)_x@(H2O)_y$

Nanomedicine is a new direction and boon in human health care. However, we should be very careful using nanoproducts, because they may give huge benefits in health care, but also big disadvantage. There is similarity between natural phenomena and nanotechnology solutions in medicine. The Sun is producing UVC and other radiations, of which some are

very dangerous for life. Since the Earth has ozone belt and atmosphere only beneficial light penetrate and interact with a matter on the Earth surface, giving and supporting life. Similar situation is with the molecule C60 (Fig.1.1), which generates beneficial vibration (the golden mean), but is toxic in some concentration. To solve this problem the water soluble molecule having hydroxyl groups (Fig.1.2), which has water stabilizing belt around carbon-hydroxyl molecule (Fig.1.3) is produced. This is water based nano harmonized substance (wNHS) for nanomedicine. In the last fifteen years molecule C60 has been using in research and development for many applications including biomedicine. Having hydroxyl groups and nanolayering water belt for the first time is safe and beneficial.

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Đorđe G. Kozić
Faculty of Mechanical Engineering
University of Belgrade
Serbia

WATER - FROM UNIQUE PROPERTIES SUSTAINING LIFE TO INSPIRATION OF ARTISTS

Through the complete history of mankind and religion, it has been known that water possesses properties that could not be found in any other substance. It is omnipresent and in immense quantities, in all three phases. Speaking on physical aspects, it has the largest specific heat of all liquids. Therefore, all steady and flowing waters, icebergs and water vapor in the atmosphere play a role of an enormously capacitive heat reservoir that neutralizes large climate changes. In absence of this, cosmic cold would penetrate Earth long since and transform it into a huge ice ball. Ice created on all water surfaces would overweigh water and - sink. This is not so due to property of water to expand on freezing, while all other matters (except for bismuth and cast iron) contract. Besides, it has latent vaporization (condensation) heat much higher than any other substance. So, by water vaporization itself (releasing large quantity of heat) living beings in tropic climates can maintain their temperature below the surrounding air.
Along with the cited (mostly thermodynamic) properties, well known is another property of water, to create very tough surface membrane strong enough to hold some objects that by all logic couldn't float. Another interesting fact is that at 4ºC water has minimum density (then only rising at lower and higher temperatures). This fact is of huge significance for the survival of the underwater world during winter.

Quotation in detail of all particular attributes of water is not practically possible. Lone fact that water, in its broadest sense, consists of hydrogen and oxygen, including their possible isotopes, complicates any further consideration. However, one should mention the existence of light, natural and heavy water (the last is especially important for power production), then live and dead water. Also, it is true that nobody has ever had a chance to

get in touch with chemically pure water - it always contains other substances dissolved in it. This is due to extremely high value of its dielectric constant, making water the most powerful dissolver. Apart of all said above, it is interesting that these particularities of water are the necessary ones to sustain life processes - in the most basic sense of that word.
It is not unexpected that water, the most wonderful substance in the world, has driven attention of many an artist. Beside its purely physical uncommonness, water has always been regarded as a symbol. Diverse aspects of water have been described in myths, religious and folklore texts via its allegoric and metaphoric meanings. And flowing waters, and still waters, and waterfalls, and aqueducts, but - and water demolishing all ahead - are topics that artists and poets could not resist to. As well, many a musical masterpiece has directly been inspired by the rhythm of raindrops and an endless variety of water jet dances in fountains.

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Dragoljub Lj. Mirjanić
Academy of Sciences and Arts of the Republic of Srpska
Republic of Srpska, B&H
Ana J. Šetrajčić-Tomić
Medical Faculty, Department of Pharmacy,
Novi Sad, Serbia
Jovan P. Šetrajčić
Academy of Sciences and Arts of the Republic of Srpska
Republic of Srpska, B&H

SHELL-NANOSTRUCTURED MATERIALS FOR BIOPHARMACY AND BIOMEDICINE

Science is nowadays very interested in low-dimensional systems, the dimensions of order of even few nanometers, which, in practical application, demonstrate exceptional characteristics in various fields. The need to minimize dimensions was imposed by a number of inter-related and mutually dependent requests of modern civilization, probably key to its further survival and sustainable development, which can generally be categorized as belonging to the fields of energy, health and ecology. In that sense, the subject of the research in this work will include nanomaterials in the field of biopharmaceutical technology for biomedical application. This includes the very precise encapsulated drag delivery, on exactly defined place/site in the human tissue or organ and disintegration of capsule - drug carrier, because start functioning of medicaments.

The goal of multidisciplinary researches with biocompatible molecular nanomaterials is to find the parameters and the possibilities to construct border surfaces that will, in interaction with biological environment, create such properties of nanolayers that are convenient for use for layers of drug carrier capsules, biochips and biomarkers These layers should demonstrate controlled disintegration of structure, better differencing dielectric properties, discrete selective luminescence and appropriate bioporosity as all these are the requirements of contemporary nanomedicine. The ultimate goal of the proposed research is to sample, test and verify, in experimental manner, the results of theoretical research aimed at improvement of the proposed models for creating the structures of biocompatible nanolayers for nanomedicine, by using contemporary methods and latest devices based on electronic microscopy (AFM, MFM and OMF). Based on our research in ultrathin crystal structures performed so far, superlattices, Q-wires and Q-dots, we will consider the materials that can act as carriers for medicines and tagged substances. For this purpose we established a shall-model of ultrathin molecular crystals and investigated their dielectric, particularly optic characteristics. This research we splend with help of twotime dependent Green's function method, adjusted to ultrathin crystalline structure analysis. It is showen that specific resonant absorption lines appears in these structures, which number depends on crystal layers position and on values of parameters on shell-structure boundary surfaces. The absorption of electromagnetic radiation declines in infrared part and its detection is relatively easy process.

In this paper we will analyze application of nanomaterials in biomedicine, that is to say we will present the recent accomplishments in basic and clinical nanomedicine. Numerous novel nanomedicine-related applications are under development or are in the research

phase, and the process of converting basic research in nanomedicine into commercially viable products will be long and difficult. Achieving full potential of nanomedicine may be years of even decades away however potential advances in drug delivery diagnosis and development of nanotechnology-related drugs start to change the landscape of medicine. Site-specific targeted drug delivery (made possible by the availability of unique delivery platforms such as dendrimers nanoparticles and nanoliposomes) and personalized medicine (result of the advance in pharmacogenetics) are just a few concepts on the horizont of research.

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Milena Papić-Obradović
Clinic of Gynecology and Obstetrics-Narodni front
Kraljice Natalije 62, 11000 Belgrade, Serbia

WATER IN HUMAN EMBRYOGENESIS AND AGING

The human embryo is composed primarily of Water. The Essence of man (sperm) and woman (egg) unite in the uterine sea to form the fetus. The syncyciotrophoblast help to implant the embryo in the endometrium. Embryo 6 weeks of age contains 97.5% water and the born about 83%. The dynamics of water, the creation and dismantling of clusters in the embrio as wel as amnion liquid is accompanied by dynamic paramagnetism /diamagnetism, as a consequence of the dynamics of water and its interactions with components that are dissolved in it. Biological water at the interface of proteins is critical to their equilibrium structures and enzyme function and to phenomena such as molecular recognition and protein-protein interactions. The structure of water in the boundary layer is determined by geometry of protein hydrogen bounds surrounding, a spatially organized molecular structure of water allows activation of biomolecules and therefore cell. When water changes from its dense, weakly bonded state, to its open, strongly bonded state, there is a decrease in its energy term because molecules make stronger hydrogen bonds, and this helps to decrease its chemical potential. However, at the same time, the liquid changes from a rather random structure to a much more ordered structure. Experiments were carried out on rats, which consumed the water different mineral composition with one invalid drinking. During pregnancy rats and embrios and sacrificed them and made a histological and nanotechnology AFM/MFM (Atomic Force Mycroscopy/ Magnetic Force Mycroscopy, JEOL Japan) method. A number of animals was sacrificed after the birth or given off spring, and it is also examined. The results indicate a substantial impact of different types structural water and mineral composition of embryonic development, reduce the number of birds and increasing of cannibalism. Partitioning of solutes between the cell and extracellular solution was not determined solely by the permeability of the membrane, but that protoplasm itself preferentially accumulated some solutes and excluded others. The speed of this process, changes of ions, the different in tissues exhibited various types of water. Characterization of supramolecular morphologycal structure of biopolymer enables understanding of biopolymer interactions with waters of different structure and mineral composition of the proces of development.

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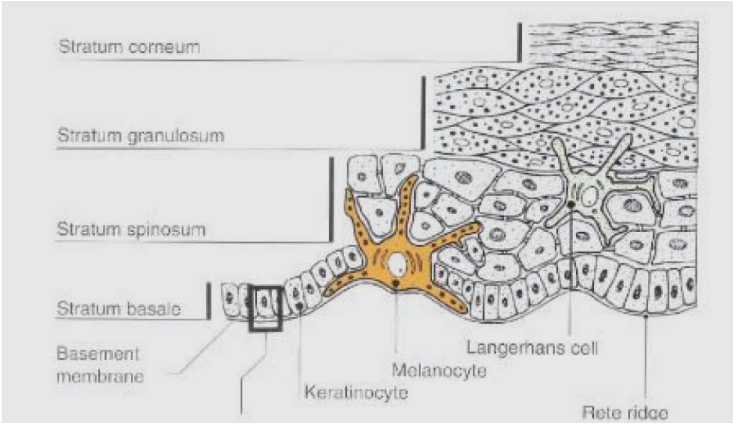
Suzana Miljković
Galenika, Inc, Zemun, Serbia
Dušan Kojić, Lidija Matija, Jadran Bandić*, Goran Janjić
NanoLab, University of Belgrade, Serbia
*ORS Hospital, Belgrade, Serbia

WATER NANO-LAYERS IN HUMAN SKIN

According to most literature data, the skin is usually observed as a simple structure with equivalent electrical model, which include general properties of epidermis, basal membrane and dermis. In this paper, we analyzed the skin structure as a more complex system. Particularly we analyzed epidermis from layers approach and its water organization in nano ordered sublayers. Using opto-magnetic fingerprint (OMF) method, which is very sensitive to paramagnetic diamagnetic properties of tissue, we found out that lipid-water structure ordering in layers play very important role in skin properties.



We investigate human epidermis properties for two different types of drinking waters, normal (N) and on edge to be normal (Z). We use fifteen volunteers who have been drinking Z water for years and five people who are drinking N water. For all of them we characterized surface of skin by OMF, then we remove stratum corneum by sticking plaster and characterized first layer of stratum granulosum by OMF, than we removed first half of stratum granulosum and characterized it, and finally we removed second half part of stratum granulosum and characterized the first layer of stratum spinosum. From day of experiment to next six weeks ten volunteers who drank Z water, start to drink N water. After eight weeks we make epidermis characterization by OMF. Five people who are drinking N water and five people who are drinking Z water become control group.
In our initial investigation we are fond out difference of skin properties of people who change from Z to N drinking water. The significant difference posses middle part of

stratum granulosum, where water-lipid sublayers exist. These preliminary results indicate impotence of water nanolayers presence in epidermis and type of drinking water for human skin properties.

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Goran Janjić
NanoLab, PhD Programme
Multidisciplinary Study, University of Belgrade
Belgrade, Serbia

ETRACELLULAR/INTACELLULAR AND FREE/CAPTURE WATER IN HUMAN ORGANISM

Content of water in the body of man decrease with age, and the largest decrease occurs in the first 10 years. Intracellular liquid is 2/3 (63%) total body fluid and makes 70% of the cell cytoplasm. 85% of cell water has a bulk structure while the remaining water is less mobile and related macromolecules. Closely related water in the cell is 5% while free water 95%. Extracellular fluid is 1/3 (37%) water of body of which the plasma is ¼. Bound water is physically connected to different molecular structures and can not freely and independently of the special move. Dynamics of water, creation and destruction clusters, followed by the dynamics of paramagnetism/diamagnetism, this phenomenon occurs in all cells and tissues and as consequence of the dynamics of water and its interaction with components which are dissolved therein. Tissues were recorded by OMF device and nanotechnologycal method AFM/MFM. Time, seriously distort the relationship of free and bound water, ie. bound water becomes predominant, then there is disruption of many metabolic functions, which causes significant changes in cell and tissue. AFM/MFM are used to enable research electric nonconductive biopolymers and related water in association with them. The experiment was performed on rats with different water types of which one was not drinking. Various types of water-related impact on the relationship associated and free water in tissues and cells, primarily related to increasing the amount of bound water depending on the level of their clusterization and mineral composition. Research suggests the possible application in nanodiagnosis with the aim recognition disease in which an earlier stage.

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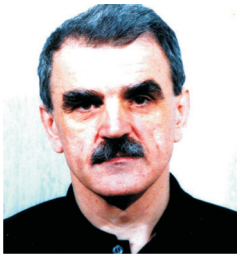

Čeda Lalović
NanoLab, PhD Programme
Faculty of Mechanical Engineering
University of Belgrade, Serbia

Dušan Kojić, Spomenko Mihajlović*
NanoLab, University of Belgrade, Serbia
*Geomagnetic Institute, Grocka, Serbia

WATER HYDROGEN BONDS AND GOLDEN RATIO OF 1.618

Hydrogen bond and its nature play attention in scientific community until 1902, when German scientist Werner use words nebenvalenz and innere komplexsalzbildung to describe intra and intermolecular bonds which are not covalent. However, hydrogen bond becomes commune term when Pauling gives systematic concept of the hydrogen bond in the chemistry In spite that he proposed that hydrogen bond in water is not only classical electrical attraction between a positively charged hydrogen atom and a negatively charged oxygen atom, but it also should be affected by the sigma bonds, no one take his proposal seriously until 1999, when it was experimentally shown that hydrogen bond posses covalency and has both classical and quantum properties.

From experimental data based on neutron diffraction it has been clear that product of distance between center of hydrogen and oxygen atoms in covalent bond d(O-H) of different structures is between 95 pm and 120 pm, while distance of center of hydrogen and oxygen atoms in non-covalent bond d (O...H) is between 120 pm and 200 pm. However, for each type of matter product value d(O-H) x d (O...H) is about 162 pm. Systematic investigation and quantitative analysis of bond lengths of O-H...O showed that bond-valence parameters of hydrogen bonds follow Golden ratio role, which value is 1.618. Bearing in mind that water is one of the richest structure with hydrogen bonds, which may be organized in molecular networks, indicates that water via hydrogen bonds (with classical and quantum properties), may play a role in molecular and biomolecular recognition. From this point of view, two primary goals in today pharmacy are understanding mechanism of molecular recognition in water solution and water structure for drug design. At present time, some pharmacologists become aware about importance of water structure for drug design, because modeling ligand-receptor interaction it has to include specific geometric which relates to water structure. It is well known that hydrogen bonds are link between two nucleotide chains in DNA and support existence secondary, ternary and quarterly structure of proteins Since hydrogen bonds play important role in water, biomolecular structures, hydrated crystals and nanostructures we start to do research to characterized water and its hydrogen bonds by opto-magnetic method. By this method, based on light-water interaction, it is possible to collect data of both classical and quantum actions of water molecules and interactions between them.

Zorana Golubović
Department of Bioengineering - Innovation Centre
Faculty of Mechanical Engineering
University of Belgrade, Serbia

THE RETENTION OF WATERBORN ORGANIC MOLECULE WITH NANOFILTRATION

One of the most important recent advances in membrane technology has been the development of nanofiltration membranes. Nanofiltration is a very complex pressure-driven separation process, which is widely used in water treatment (fractionate or purify aqueous solutions of organic solutes having molecular weight between 100 and 500 g/mol and mixtures of monovalent/multivalent salts). Therefore, an important challenge is to develop models that convey a fundamental understanding and simple quantification of the governing phenomena in a way that has the potential for a wide variety of applications. The pore size distribution of the membrane is not taken into account in some water nanofiltration models. However, this is a key element for the description of the retention of organic molecules. The integral of this distribution reflects the maximal retention for a given molecule, when transport through the membrane occurs only by convection.
The pore size distribution and the experimental water flux through the membrane were used to calculate the retention as a function of pressure for the membranes under consideration. This enables defining the retention curves at different pressures. The relationship between molecular weight and pressure can be formulated also.
The evaluation of the retention for water-born organic molecules enables a quantitative characterization of the nanofiltration membrane performance at different pressures. Output data points are scattered around the trend lines. This is a direct consequence of limited experimental accuracy and some variations of properties that characterize different pieces of the membrane.

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Dušan Kojić
NanoLab, Faculty of Mechanical Engineering
University of Belgrade, Serbia

Aleksandar Tomić, Čedomir Lalović, Đuro Koruga
NanoLab, Faculty of Mechanical Engineering
University of Belgrade, Serbia

WATER CHARACTERIZATION BY OPTO-MAGNETIC FINGERPRINT

New physical method for characterization of mater, denoted as opto-magnetic fingerprint, we developed using specifically Raman type spectra in physiologically diffuse white and polarized white light (Koruga, Tomic, 2009). This method gives a lot possibility for description of mater, and a non invasive reliable method for medical diagnostics. (Tomic A, 2010).It gives importance to all investigation by this tool, especially connected with bio-molecules.
As water is important partial contents of tissue we successfully investigate in purposes of characterization many water solutions, especially mineral waters. In these experiments we obtained unexpected results, too – that in water layer with thickness smaller than critical , all tested waters, previously with significant different Raman spectra, shown the same spectral response – result equivalent to measurement of Pollack et all. (Pollack, 2010) confirming on independent way existence of exclusion zone in water, in which physical properties are very different than in bulk water.
How water layer are relatively think, we prefer description as 'physical properties of think film' instead of 'fourth phase' of water, however properties are absolute different than in standard measures. Description of experiment and obtained results would be presented, including identification of magnetic properties of water.
How this method is very simple to application, and giving reliable repeatable results from these follows method fee in science and technology.

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Aleksandar Tomić
NanoLab, PhD Programme
Faculty of Mechanical Engineering
University of Belgrade, Serbia

Lidija Matija, Zorana Golubović, Željko Ratkaj,*
Đuro Koruga
NanoLab, Faculty of Mechanical Engineering
University of Belgrade, Serbia
*MySkin,Inc.,Gospodar Jevremova 47,
11000 Belgrade, Serbia

CELLULAR AND INTRACELLULAR HYDROGEN BONDS AND PROTON TRANSPORT BY MICROTUBULES

It is known that water in cell and intracellular space gives important role. We here will not consider any aspect of chemical properties of water, or water interaction with biological molecules, what is also very interesting question. We were developed application of Lagrange equations to motion of atoms in molecules, applicable at unlimited number of connected atoms (Tomić et all, 2004). It does possibility to extract a lot newly properties of atom in molecular connection, especially in very long series as it is in peptide chains, where appeared clean specifics of secondary and tertiary organization in bio - molecule (Koruga et all. 2004). Special attention we have had on hydrogen bonds in complex bio-molecular connection and its role in propagation of information along the chain, concrete solitary wave propagation. As independent research of other colleges shown too, hydrogen bonding have multiple functions not only connecting molecules. Also, quantum physics attempts are really effective only by explanation of proton and electron transport in bio-molecules (Ivić et all, 1993). In this state theory our method gave possibility to explain hydrogen ion transport trough microtubule, as harmonized interaction of biological water into microtubule with in microtubule built atoms. Water we treated as clusters of atoms organized in optimal molecular formation. Obtained interesting result - possible manner haw microtubules realized hydrogen ion transport. Description of method and obtained results would be presented. Also 3- D simulation of atoms motion in two peptide plane, ones in which crosses phonon wave and solitary wave, and other where this event occur not. Only hydrogen bond in transversal oscillation path made all important difference. How this method is very simple to application, and giving reliable repeatable results from these follows method fee in science and technology.

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Jelena Munćan
Biomedical Engineering, PhD Programme
Faculty of Mechanical Engineering
University of Belgrade, Serbia

Đuro Koruga
Biomedical Engineering,
Faculty of Mechanical Engineering,
University of Belgrade, Serbia

WATER IN HUMAN BRAIN: NANOTECHNOLOGY APPROACH FOR ALZHEIMER'S DISEASE

Alzheimer's disease (AD) is the primary cause of dementia syndrome worldwide, with an astronomical devastating socioeconomic burden on society. It is progressive and fatal, neurodegenerative disorder causing gradual loss of memory, intellectual and psychological disturbances. Alzheimer's disease has no current preventive or curative therapy
This disorder is characterized neuropathologically by the presence of plaques composed of amyloid - β peptides and neurofibrillary tangles containing phosphorylated tau2. According to amyloid cascade hypothesis, accumulation of amyloid beta protein is the initial step in AD pathogenesis. The two main hallmarks of disease are accompanied by the synapse loss, neuronal degeneration, neuroinflammation, oxidative damage, disturbances in numerous neurotransmitter systems, and disruption of metal homeostasis and fluid and electrolyte homeostasis.

With the minimal regeneration capacity of the brain, it is of vital importance to prevent development and progression of pathogenic processes resulting in known pathological changes. As a technology which operates on nanoscale, nanotechnology offers possibility to intervene in molecular events leading to progression of disease, through direct interactions between nanomaterials and biological molecules. Nanotechnology also offers a noninvasive access brain, which is not achievable by other approaches. Designing especial nanoparticles targeted to molecules with initial role in AD pathogenesis i.e. amyloid beta, is of high importance in effective drug discovery for this disease.
With only symptomatic therapies available in the present, nanotechnology approach would be of great benefit for treating root causes of disease.

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Zoran Vosika
NanoLab, PhD Programme
Faculty of Mechanical Engineering
University of Belgrade, Serbia

Jovana Simić-Krstić, Goran Janjić, Zoran Mitrović
NanoLab, Faculty of Mechanical Engineering,
University of Belgrade, Serbia

ON USING BIOIMPEDANCE AND FRACTIONAL CALCULUS FOR SKIN HYDRATION ASSESSMENT

Electrical Bioimpedance Monitoring is an emerging tool for biomedical research and for medical practice. Electrical methods for measuring skin hydration have been studied for several decades and a low frequency susceptance method has proved to be the most appropriate. In other hand, fractional calculus is not often used to model biological systems (Magin 2004).
The impedance of the skin is dominated by the stratum corneum at low frequencies. It has generally been stated that skin impedance is determined mainly by the stratum corneum at frequencies below 10 kHz and by the viable skin at higher frequencies. This will of course be dependent on factors like skin hydration, electrode size and geometry, etc. but may nevertheless serve as a rough guideline (S. Grimnes and O. Martinsen 1998,2008). The Cole-Cole equation has been found able to model most electrical measurements on biological tissue, including skin. However, the impact of her skin hydration by layers to bioelectrical properties is not fully tested.
In our laboratory, the basis for this type of experiments is a generalized Cole-Cole equation. It is obtained by applying the new method in fractional calculus. Our fractional model presents the generalized continuous Cole - Cole model which may predicts structural - functional parameters as a lot of Cole-Cole complex relaxation times. These relaxation time constants correspond to structural - functional characteristics of the skin layers. Some of these features are its dielectric properties, fractality its structure, water content in the skin etc.
This research, due to noninvasion applied techniques can contribute to a better characterization of any tissue, the appropriate biomaterial. This represents a good basis for the development of new technologies in various fields of Bioengineering.

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Nikola Jagodić
Ophtamology Unit, Optix, Inc., Zemun, Serbia

Dragomir Stamenković, Božica Bojović*, Nevena Stevanović*
Optix, Inc., Zemun, Serbia
*Faculty of Mechanical Engineering,
University of Belgrade, Serbia

CONTACT LENSES RAFNESS AND WATER NANOLAYERS FUNCTIONALITY

Introduction
Using TF substitutes while wearing CL is recommended to improve on-eye comfort and performance by improving water component of the human tear film.

Problem
It is well known that surface roughness of RGP CL is enhancing CL deposition of different chemical compounds as well as microorganism adhesion. This study compared CL's surface roughness in worn CL samples taken from the eyes that were and were not treated with tear film substitutes.

Method
Sixteen RGP CL wearers with mild signs and symptoms of CL related dry eye syndrome were randomly fitted with LedaPermTM spherical RGP CL (Optix Contact Lens Laboratory, Zemun, Serbia), Boston XO material (Polymer Technologies, Boston, USA). Lenses were worn for 6 months on a full time basis with the same care regimen by all wearers, and then taken for evaluation. Eight CL wearers were not and the other 8 were using TF substitutes (either Systane by Alcon or Refresh Contacts from Allergan) 4 times a day. The front surface of sampled lenses were evaluated with atomic force microscopy (characteristics of the microscope) in tapping mode at 3 randomized locations over *50*µm*2 area.* Median values of average roughness (in nm) were taken for each sample.

Expectations
Average roughness was significantly higher in CL samples that were not under influence of TF substitutes while worn, comparing to CL samples that were influenced by TF substitutes. (Data in nm)

Conclusions
Less front surface roughness in CL taken from eyes treated with TF substitutes than from untreated eyes suggests the importance of the proper pre-lens TF functionality and the potency of the tear film substitutes in keeping CL front surface smoother, hence reducing protein/lipid deposition and bacteria adhesion.

Dragomir Stamenković
Optix, Inc., Zemun, Serbia

Nikola Jagodić, Manuel Conte*, Đuro Koruga
Optix, Inc., Zemun, Serbia
*Soleko Inc., Italy
NanoLab, Faculty of Mechanical Engineering
University of Belgrade, Serbia

NANOPHOTONIC CONTACT LENSES BASED ON HYDROGEN BONDING MATERIAL

Contact lens manufacturing represents one of the fastest growing sectors in medical device industry. To continue and further develop this trend and further enhance production quality and therapy efficiency it needs the application of non-destructive surface analysis methods on the nanometer scale with minimal sample preparation.
Many interesting studies have been performed on CL using AFM that investigated the surface morphology under various conditions. Two research approaches can be perceived from the literature: one aimed at surface modification and the other that was concerned with varying or simulating exploitation parameters. In both cases morphology of CL surface was the main parameter used to describe behavior and quality of material under deterioration influences.
In this study we used standard non-doped PMMA lenses and the combination of three methods in order to investigate their near-surface magnetic and optical properties: AFM/MFM, opto-magnetic fingerprint and UV/VIS spectroscopic scanning.
Here we present novel contact lenses materials composed of poly(methyl methacrylate-PMMA), and three types of nanomaterials (fullerene-C60, hydroxlate fullerene C60(OH)24 and metformin hydroxlate fullerene C60(OH)12(OC4N5H10)12. Therefore, we investigated all three types contac lenses by UV-VIS spectroscopy, phase contrast atomic force microscopy (PC-AFM), magnetic force microscopy (MFM), and optomagnetic fingerprint (OMF) technique and found out that optical properties of nanophotonic lenses are more closer to human eye light sensitivity than classical contact lenses composed only of PMMA. Nanomaterials of contact lenses have influence on physical properties of light transmission and that these changes can be detected by UV/VIS spectroscopy as well as optomagnetism. These results carry significant biophysically based implications for contact lenses industry, biomedical application industry and applied optical science.

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Jovan Vojinović, Vladan Mirjanić, Slobodan Čupić
University of Banja Luka,
Faculty of Medicine, Department of Stomatology
Republic of Srpska, B&H

BOND STRENGTH OF NANOSTRUCTURE ADHESIVE MATERIALS FOR THE SURFACE OF TOOTH ENAMEL FORMING IN AQUEOUS ENVIRONMENT

Teeth are completely surrounded by aqueous phase of saliva which represents a saturated solution stabilized by protein macromolecules of sialomucin. Between the surface of enamel and saliva a biological membrane PELIKLA was placed that allows selective exchange of minerals. Although necessary for the integrity of enamel, pelikla represents the basis for connecting bacteria and creation of biofilms, the metabolic activities of which create conditions for development of tooth decay and periodontal diseases.
The basic method of bonding classic materials for tooth tissues is primarily of the mechanical type, and the first one was on macro level through removing of the part of intact tooth tissue in order to create retention niches, using anatomic parts of tooth. Micromechanical retention, with the use of acids that etch the enamel or dentin surface and create crevices in which restorative resin tags penetrate, was revolutionary.
The above properties could not be applied in practice until the development of glass ionomer cements at the end of 70s of the last century. At that time appeared the first material capable of creation a chemical bond as a consequence of interaction of aqueous film on enamel surface with polymolecules and mineral complexes that form the material itself. The basis is chemical acid-base reaction in aqueous environment between acidic polyelectrolite and the aluminosilicat glass. This bonding is carried out in two stages. The first stage is dominated by calcium and zinc ion release from glass that connects the polymolecules of organic acid in unstable gel. More stable bonds are created with aluminum release. Subsequently, the trivalent Aluminum ions react for at least 48 hours. Between 20 and 30% of the glass is decomposed by the proton attack. The Fluoride and Phosphate ions are insoluble salts and complexes. The Sodium ions form a silica gel. The structure of the fully set cement is a composite of glass particles surrounded by silica gel in a matrix of Polyan-ions cross-linked by ionic bridges. Within the matrix are small particles of Silica gel containing fluorite crystallites. Glass Ionomer Cements bond chemically to dentine and enamel during the setting process. The mechanism of bonding appears to involve an ionic interaction with Calcium and/or Phosphate ions from the surface of the enamel or dentine. Bonding is more affective with a cleaned surface provided cleaning does not remove an excessive amount of Calcium ions. Treating dentine with an acidic conditioner followed by a dilute solution of ferric chloride improves the bonding. The cleansing agent removes the smear layer of dentine while the Fe+3 ions are deposited and increase the ionic interaction between the cement and dentin. Also, as the initial Calcium cross-links are replaced by Aluminium cross-links, most Sodium and Fluoride ions do not participate in the cross linking of the cement, however some Sodium ions may replace the Hydrogen ions of carboxylic groups whereas the remaining ions are dispersed uniformly within the set cement along with Fluorine ions. The cross linked phase becomes hydrates over time with the same water used for mixing. This process is called “maturation”.
Water plays a critical role in the setting of GIC. It serves as the reaction medium initially and then slowly hydrates the cross linked agents thereby yielding stable gel structure that is

stronger and less susceptible to moisture contamination. However, solutions of poly acrylic acid tend over a period of time to gel when their concentration in water approaches 50% by mass. This is attributed to slow increase in intermolecular hydrogen bonds. Poly acrylic acid chains are flexible and are constantly changing their configurations; when segments of a pair of chains approach each other, an intermolecular hydrogen bond can be formed.
The paper analyzes the strength of chemical bond created between glass ionomer materials and enamel surface. Glass ionomer used consists of powder and liquid. Powder is made of strontium aluminum flour-silicate, whereas liquid is the aqueous solution of polyacrylic maleic acid to which optically active D(+) isomer of tartaric acid is added, which decreases the bonding speed and increases the hardness of material. According to manufacturer's recommendation, the best bond is achieved if conditioned surface is covered by a thin layer of water, then the powder and liquid are mixed and the resulting paste is placed on the bracket and attached to tooth. Debonding was done by way of single-axial Stretch system, and after that the bond strengths were calculated for specific adhesives.

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Slobodan Čupić, Vladan Mirjanić, Jovan Vojinović
University of Banja Luka,
Faculty of Medicine, Department of Stomatology
Republic of Srpska, B&H

COMPARATIVE ANALYSIS OF BOND STRENGTH OF COMPOSITE MATERIALS TO TOOTH SURFACE WITH MATERIALS THAT REACT IN AQUEOUS ENVIRONMENT

Most therapeutic treatments on teeth requires application of different materials and their bonding for enamel surface in order to compensate for the tooth tissue or apply medicaments or forces necessary to move teeth. In addition to ultimate biocompatibility and stability in the environment of aqueous solution of saliva, an ideal material should also provide chemical bonding to tooth tissues or metals, thermal compatibility with mineralized tissues and anticariogenic properties. Contemporary adhesive materials create bond to enamel surface in a chemical way or by creating micro-mechanical retentions. The latter method is less natural as it damages the tooth surface and requires complete removal of biological microfilm and absence of water in bonding stage.

Glass ionomer cements are contemporary materials that are unique in terms of creation of complete chemical bond with hydroxyl apatite of enamel. It is generally recognized that ionic bonding is the principal mechanism of adhesion. The cement adheres to the apatite structure by hydrogen bonding. However, as the cement hardens, the hydrogen bonds are replaced by metal ions, thereby producing a metal ion bridge. The cement may also bond or adhere to the dentinal collagen through hydrogen and ionic bonding. According to the manufacturer's recommendation, the best bond is achieved if the conditioned surface is covered by a thin layer of water.

Composite resins are also applied, but they require treating the enamel surface with strong inorganic acids that decompose the interprysm spaces more intensively and create "microtags" into which resin penetrates thus creating retention. The presence of water is undesired as it makes penetration of resin into tags more difficult.

In this paper a comparative analysis has been made between the strength of the chemical bond made with glass-ionomer cement and mechanical bond made with composite resins.

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