Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted 'tubular' polar areas of magnetic fields and hassium nanoparticles

Alireza Heidari1,2*, Katrina Schmitt1, Maria Henderson1 and Elizabeth Besana1

1Faculty of Chemistry, California South University, 14731 Comet St. Irvine, CA 92604, USA
1American International Standards Institute, Irvine, CA 3800, USA

Abstract

In the current study, thermoplasmonic characteristics of Hassium nanoparticles with spherical, core-shell and rod shapes are investigated. In order to investigate these characteristics, interaction of synchrotron radiation emission as a function of the beam energy and Hassium nanoparticles were simulated using 3D finite element method. Firstly, absorption and extinction cross sections were calculated. Then, increases in temperature due to synchrotron radiation emission as a function of the beam energy absorption were calculated in Hassium nanoparticles by solving heat equation. The obtained results show that Hassium nanorods are more appropriate option for using in optothermal human cancer cells, tissues and tumors treatment method.

Scanning Electron Microscope (SEM) image of Hassium nanoparticles with 50000x zoom.
Introduction

In recent decade, metallic nanoparticles have been widely interested due to their interesting optical characteristics [1-8]. Resonances of surface Plasmon in these nanoparticles lead to increase in synchrotron radiation emission as a function of the beam energy scattering and absorption in related frequency [9, 10]. Synchrotron radiation emission as a function of the beam energy absorption and induced produced heat in nanoparticles has been considered as a side effect in plasmonic applications for a long time [11-15]. Recently, scientists find that thermoplasmonic characteristic can be used for various optothermal applications in cancer, nanoflows and photonic [16-22]. In optothermal human cancer cells, tissues and tumors treatment, the descendent laser light stimulate resonance of surface Plasmon of metallic nanoparticles and as a result of this process, the absorbed energy of descendant light converge to heat in nanoparticles [23-25]. The produced heat devastates tumor tissue adjacent to nanoparticles without any hurt to sound tissues [26, 27]. Regarding the simplicity of ligands connection to Hassium nanoparticles for targeting cancer cells, these nanoparticles are more appropriate to use in optothermal human cancer cells, tissues and tumors treatment [28-74]. In the current paper, thermoplasmonic characteristics of spherical, core-shell and rod Hassium nanoparticles are investigated.

Heat generation in synchrotron radiation emission as a function of the beam energy-hassium nanoparticles interaction

When Hassium nanoparticles are subjected to descendant light, a part of light scattered (emission process) and the other part absorbed (non-emission process). The amount of energy dissipation in non-emission process mainly depends on material and volume of nanoparticles and it can be identified by absorption cross section. At the other hand, emission process which its characteristics are depend on volume, shape and surface characteristics of nanoparticles explains by scattering cross section. Sum of absorption and scattering processes which lead to light dissipation is called extinction cross section [75-123].

Hassium nanoparticles absorb energy of descendant light and generate some heat in the particle. The generated heat transferred to the surrounding environment and leads to increase in temperature of adjacent points to nanoparticles. Heat variations can be obtained by heat transfer equation [124-202].

Simulation

To calculate the generated heat in Hassium nanoparticles, COMSOL software which works by Finite Element Method (FEM) was used. All simulations were made in 3D. Firstly, absorption and scattering cross section areas were calculated by optical module of software. Then, using heat module, temperature variations of nanoparticles and its surrounding environment were calculated by data from optical module [203-283]. In all cases, Hassium nanoparticles are presented in water environment with dispersion coefficient of 1.84 and are subjected to flat wave emission with linear polarization. Intensity of descendant light is 1 mW/μm². Dielectric constant of Hassium is dependent on particle size [284-474].

Firstly, calculations were made for Hassium nanospheres with radius of 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 nanometers. The results show that by increase in nanoparticles size, extinction cross section area increases and maximum wavelength slightly shifts toward longer wavelengths. The maximum increase in temperature of nanospheres in surface Plasmon frequency is shown in Figure 1.

According to the graph, it can be seen that the generated heat is increased by increase in nanoparticles size. For 100 (nm) nanoparticles (sphere with 50 (nm) radius), the maximum increase in temperature is 83 (K). When nanoparticles size reaches to 150 (nm), increase in temperature is increased in spite of increase in extinction coefficient. In order to find the reason of this fact, ratio of absorption to extinction for various nanospheres in Plasmon frequency is shown in Figure 2.

Figure 2 shows that increasing the size of nanospheres leads to decrease in ratio of light absorption to total energy of descendant light so that for 150 (nm) nanosphere, scattering is larger than absorption. It seems that although increase in nanoparticles size leads to more dissipation of descendant light, the dissipation is in the form of scattering and hence, it cannot be effective on heat generation.

Heat distribution (Figure 3) shows that temperature is uniformly distributed throughout the nanoparticles which are due to high thermal conductivity of Hassium.

In this section, core-shell structure of Hassium and silica is chosen. The core of a nanosphere with 45 (nm) radius and silica layer thickness of 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 nanometers are considered. The results show that increase in silica thickness leads to increase in extinction coefficient and shift in Plasmon wavelength of nanoparticles, to some extent.

According to Figure 4, silica shell causes to considerable increase in temperature of Hassium nanoparticles but by more increase in silica thickness, its effects are decreased. Heat distribution (Figure 5) shows that temperature is uniformly distributed throughout metallic core as well as silica shell. However, silica temperature is considerably lower than core temperature due to its lower thermal conductivity. In fact, silica layer prohibits heat transfer from metal to the surrounding.
aqueous environment due to low thermal conductivity and hence, temperature of nanoparticles has more increase in temperature. Increasing the thickness of silica shell leads to increase in its thermal conductivity and hence, leads to attenuate in increase in nanoparticles temperature.

Figure 6 is drawn. This graph shows that variation of nanorod dimension ratio leads to considerable shift in Plasmon wavelength. This fact allows regulating the Plasmon frequency to place in near IR zone. Light absorption by body tissues is lower in this zone of spectrum and hence, nanorods are more appropriate for optothermal human cancer cells, tissues and tumors treatment methods.

Variations of temperature in Hassium nanorods with two effective radius and various dimension ratios are shown in Figure 7. By increase in length (a) to radius (b) of nanorod, temperature is increased.
Conclusion and summary

The calculations showed that in Hassium nanoparticles, light absorption in Plasmon frequency caused to increase in temperature of the surrounding environment of nanoparticles. In addition, it showed that adding a thin silica layer around the Hassium nanospheres increases their temperatures. Calculations of nanorods showed that due to ability for shifting surface Plasmon frequency toward longer wavelength as well as more increase in temperature, this nanostructure is more appropriate for medical applications such as optothermal human cancer cells, tissues and tumors treatments.

Acknowledgements

Authors are supported by an American International Standards Institute (AISI) Future Fellowship Grant FT120100937435. We acknowledge Ms. Isabelle Villena for instrumental support and Dr. Michael N. Cocchi for constructing graphic abstract figures. We gratefully acknowledge Prof. Dr. Christopher Brown gratefully acknowledge Prof. Dr. Christopher Brown for proof reading the manuscript. Synchrotron beam time was awarded by the National Synchrotron Light Source (NSLS-II) under the merit-based proposal scheme.

References

7. Branz, H. M.; Yost, V. E.; Ward, S.; Jones, K. M.; To, B.; Stradins, P. Nanostructured Black Silicon and the Optical Reflectance of Graded-Density Surfaces. Appl. Phys. Lett.2009, 94, 231121, 10.1063/1.3152244
8. Fazio, B.; Artoni, P.; Antonia Iati, M.; D’Andrea, C.; Lo Faro, M. J.; Del Sorbo, S.; Pirotta, S.; Giuseppe Gucciardi, P.; Musumeci, P.; Salvatore Vasi, C.; Saja, R.; Galli, M.; Priolo, F.; Ferrara, A. Strongly Enhanced Light Trapping in a Two-Dimensional Silicon Nanowire Random Fractal Array. Light: Sci. Appl.2016, 5, e16062, 10.1038/lsa.2016.62
9. Ko, M.-D.; Rim, T.; Kim, K.; Meyyappan, M.; Baek, C.-K. High-Efficiency Silicon Solar Cell Based on Asymmetric Nanowire. Sci. Rep.2015, 5, 11466, 10.1038/srep11466
10. Oh, J.; Yuan, H. C.; Branz, H. M. An 18.2%-Efficient Black-Silicon Solar Cell Achieved through Control of Carrier Recombination in Nanostructures. Nat. Nanotechnol.2012, 7, 743–748, 10.1038/nnano.2012.116
11. Lin, H.; Xie, F.; Fang, M.; Yip, S.; Cheung, H. Y.; Wang, F.; Han, N.; Chan, K. S.; Wong, C. Y.; Ho, J. C. Rational Design of Inverted Nanopencell Arrays for Cost-Effective, Broadband, and Omnidirectional Light Harvesting. ACS Nano2014, 8, 3752–3760, 10.1021/nn405048x
12. Garnett, E.; Yang, P. Light Trapping in Silicon Nanowire Solar Cells. Nano Lett.2010, 10, 1082–1087, 10.1021/nl10100161
13. Misra, S.; Yu, L.; Foldyna, M.; Roca I Cabarrocas, P. High Efficiency and Stable Hydrogenated Amorphous Silicon Radial Junction Solar Cells Built on VLS-Grown Silicon Nanowires. Sol. Energy Mater. Sol. Cells2013, 118, 90–95, 10.1016/j.solmat.2013.07.036
14. Kelzenberg, M. D.; Boettcher, S. W.; Petykiewicz, J. A.; Turner-Evans, D. B.; Putnam, M. C.; Warren, E. L.; Spurgeon, J. M.; Briggs, R. M.; Lewis, N. S.; Atwater, H. A. Enhanced Absorption and Carrier Collection in Si Wire Arrays for Photovoltaic Applications. Nat. Mater.2010, 9, 239–244, 10.1038/nmat2635
15. Tian, B.; Zheng, X.; Kempa, T. J.; Fang, Y.; Yu, N.; Yu, G.; Huang, J.; Lieber, C. M. Coaxial Silicon Nanowires as Solar Cells and Nanoelectronic Power Sources. Nature2007, 448, 885–889, 10.1038/nature06181
16. Razek, S. A.; Swillam, M. A.; Allam, N. K. Vertically Aligned Crystalline Silicon Nanowires with Controlled Diameters for Energy Conversion Applications: Experimental and Theoretical Insights. J. Appl. Phys.2014, 115, 194305, 10.1063/1.4876477
17. Dhinda, N.; Valia, J.; Saini, S. A. Platform for Colorful Solar Cells with Enhanced Absorption. Nanotechnology2016, 27, 495203, 10.1088/0957-4484/27/49/495203
18. Dhinda, N.; Valia, J.; Pathirane, M.; Khodadad, I.; Wong, W. S.; Saini, S. A. Adjustable Optical Response of Amorphous Silicon Nanowires Integrated with Thin Films. Nanotechnology2016, 27, 145703, 10.1088/0957-4484/27/14/145703
19. Zhu, J.; Yu, Z.; Burkhard, G. F.; Hsu, C.-M.; Connor, S. T.; Xu, Y.; Wang, Q.; McGhee, M.; Fan, S.; Cui, Y. Optical Absorption Enhancement in Amorphous Silicon Nanowire Nanocone Arrays. Nano Lett.2009, 9, 279–282, 10.1021/nl802886y
20. Klinger, D.; Lukasiewska, E.; Zymierska, D. Nano-Structure Formed by Nanosecond Laser Annealing on Amorphous Si Surface. Mater. Sci. Semicond. Process.2006, 9, 1082–1087, 10.1021/nl100161z
21. Kumar, P.; Krishna, M. G.; Bhattacharya, A. Excimer Laser Induced Nanostructuring of Silicon Surfaces. J. Nanosci. Nanotechnol.2009, 9, 3224–3232, 10.1016/j.acl.2006.01.027
22. Kumar, P.; Singh, S.; Bhattacharya, A. Excimer Laser Induced Nanostructuring of Silicon Surfaces. J. Nanosci. Nanotechnol.2010, 10, 231121, 10.1063/1.3152244
23. Adikaari, A. A. D. T.; Silva, S. R. P. Thickness Dependence of Properties of Excimer Laser Textured Nanowires with Different Cross-Sectional Geometries. Nano Lett.2016, 16, 3752–3760, 10.1021/acs.nanolett.6b00236
24. Garnett, E.; Yang, P. Light Trapping in Silicon Nanowire Solar Cells. Nano Lett.2010, 10, 1082–1087, 10.1021/nl10100161
25. Lin, H.; Xie, F.; Fang, M.; Yip, S.; Cheung, H. Y.; Wang, F.; Han, N.; Chan, K. S.; Wong, C. Y.; Ho, J. C. Rational Design of Inverted Nanopencell Arrays for Cost-Effective, Broadband, and Omnidirectional Light Harvesting. ACS Nano2014, 8, 3752–3760, 10.1021/nn405048x
26. Garnett, E.; Yang, P. Light Trapping in Silicon Nanowire Solar Cells. Nano Lett.2010, 10, 1082–1087, 10.1021/nl10100161
27. Jin, S.; Hong, S.; Mativenga, M.; Kim, B.; Shin, H. H.; Park, J. K.; Kim, T. W.; Jang, J. Low Temperature Polymerystalline Silicon with Single Orientation on Glass by Blue Light Annealing. Thin Solid Films2016, 616, 838–841, 10.1016/j.tsf.2016.02.026
Heidari A (2020) Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted 'tubular' polar areas of magnetic fields and hassium nanoparticles

Dent Oral Maxillofac Res, 2020        doi: 10.15761/DOMR.1000340

108. Heidari, “Simulation of Temperature Distribution of DNA/RNA of Human Cancer Cells Using Time–Dependent Bio–Heat Equation and Nd: YAG Lasers”, Arch Cancer Res. 4: 2, 2016.

109. Heidari, “Quantitative Structure–Activity Relationship (QSAR) Approximation for Cadmium Oxide (CdO) and Rhodium (III) Oxide (Rh2O3) Nanoparticles as Anti–Cancer Drugs for the Catalytic Formation of Provirial DNA from Viral RNA Using Multiple Linear and Non–Linear Correlation Approach”, Ann Clin Lab Res. 4: 1, 2016.

110. Heidari, “Biomedical Study of Cancer Cells DNA Therapy Using Laser Irradiation at Presence of Intelligent Nanoparticles”, J Biomedical Sci. 5: 2, 2016.

111. Heidari, “Measurement the Amount of Vitamin D (Ergocalciferol), Vitamin D3 (Cholecalciferol) and Absorbable Calcium (Ca++) in Iron (II) (Fe2+), Magnesium (Mg2+), Phosphate (PO4–) and Zinc (Zn++) in Apricot Using High–Performance Liquid Chromatography (HPLC) and Spectroscopic Techniques”, J Biom Biostatol 7: 292, 2016.

112. Heidari, “Spectroscopy and Quantum Mechanics of the Helium Dimer (He2), Neon Dimer (Ne2), Argon Dimer (Ar2), Krypton Dimer (Kr2), Xenon Dimer (Xe2), Radon Dimer(Rn2) and Ununactonium Dimer (Uuo2) Molecular Cations”, Chem Sci J 7: e112, 2016.

113. Heidari, “Human Toxicity Photodynamic Therapy Studies on DNA/RNA Complexes as a Promising New Sensitizer for the Treatment of Malignant Tumors Using Bio–Spectroscopic Techniques”, J Drug Metab Toxicol 7: e129, 2016.

114. Heidari, “Novel and Stable Modifications of Intelligent Cadmium Oxide (CdO) Nanoparticles as Anti–Cancer Drug in Formation of Nucleic Acids Complexes for Human Cancer Cells Treatment”, Biochem Pharmacol (Los Angel) 5: 207, 2016.

115. Heidari, “A Combined Computational and QM/MM Molecular Dynamics Study on Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a–BNNTs) and Hexagonal Boron Nitride Nanotubes (h–BNNTs) as Hydrogen Storage”, Struct Chem Crystallogr Commun 2: 1, 2016.

116. Heidari, “Pharmacological and Analytical Chemistry Study of Cadmium Oxide (CdO) Nanoparticles Synthesis Methods and Properties as Anti–Cancer Drug and its Effect on Human Cancer Cells”, Pharm Anal Chem Open Access 2: 113, 2016.

117. Heidari, “A Chemotherapeutic and Biospectroscopic Investigation of the Interaction of Double–Standard DNA/RNA–Binding Molecules with Cadmium Oxide (CdO) and Rhodium (III) Oxide (Rh2O3) Nanoparticles as Anti–Cancer Drugs for Cancer Cells’ Treatment”, Chem Open Access 5: e129, 2016.

118. Heidari, “Pharmacokinetics and Experimental Therapeutic Study of DNA and Other Biomolecules Using Lasers: Advantages and Applications”, J Pharmacokinet Exp Ther 1: e005, 2016.

119. Heidari, “Determination of Ratio and Stability Const of DNA/RNA in Human Cancer Cells and Cadmium Oxide (CdO) Nanoparticles Complexes Using Analytical Electrochemical and Spectroscopic Techniques”, Insights Anal Electrochem 2: 1, 2016.

120. Heidari, “Discriminate between Antibacterial and Non–Antibacterial Drugs Artificial Neural Networks of a Multilayer Perceptron (MLP) Type Using a Set of Topological Descriptors”, J Heavy Met Toxicity Dis. 1: 2, 2016.

121. Heidari, “Combined Theoretical and Computational Study of the Belousov–Zhabotinsky Chaotic Reaction and Currits Rearrangement for Synthesis of Mechlorethamine, Cisplatin, Streptozotocin, Cyclophosphamide, Melphalan, Busulphan and BCNU as Anti–Cancer Drugs”, Insights Med Phys. 1: 2, 2016.

122. Heidari, “A Translational Biomedical Approach to Structural Arrangement of Amino Acids’ Complexes: A Combined Theoretical and Computational Study”, Transl Biomed. 7: 2, 2016.

123. Heidari, “Ab Initio and Density Functional Theory (DFT) Studies of Dynamic NMR Shielding Tensors and Vibrational Frequencies of DNA/RNA and Cadmium Oxide (CdO) Nanoparticles Complexes in Human Cancer Cells”, J Nanomedicine Biotherapeutic Discov 6: e144, 2016.

124. Heidari, “Molecular Dynamics and Monte–Carlo Simulations for Replacement Sugars in Insulin Resistance, Obesity, LDL Cholesterol, Triglycerides, Metabolic Syndrome, Type 2 Diabetes and Cardiovascular Disease: A Glycobiological Study”, J Glycobiol 5: e111, 2016.

125. Heidari, “Synthesis and Study of 5–[(Phenyldisulfanyl)Amino]–1,3,4–Thiadiazole–2–Sulfonamide as Potential Anti–Ferrius Drug Using Chromatography and Spectroscopic Techniques”, J Med (Chromatographic) Retention Relationships (QSRR) Models for Analysis 5–7 2016.

126. Heidari, “Nitrogen, Oxygen, Phosphorus and Sulphur Heterocyclic Anti–Cancer Nano Drugs Separation in the Supercritical Fluid of Ozone (O3) Using Smooth–Redlich–Kwong (SRK) and Pang–Robinson (PR) Equations”, Electronic J Biol 12: 4, 2016.

127. Heidari, “An Analytical and Computational Infrared Spectroscopic Review of Vibrational Modes in Nucleic Acids”, Austin J Nanomedicine 3 (1): 1058, 2016.

128. Heidari, C. Brown, “Phase, Composition and Morphology Study and Analysis of Os/Pd/Hf Nanocomposites”, Nano Res Appl. 2: 1, 2016.

129. Heidari, C. Brown, “Vibrational Spectroscopic Study of Intensities and Shifts of Symmetric Vibration Modes of Ozone Diluted by Cumene”, International Journal of Advanced Chemistry, 4 (1) 5–9, 2016.

130. Heidari, “Study of the Role of Anti–Cancer Molecules with Different Sizes for Decreasing Corresponding Buck Tumor Multiple Organs or Tissues”, Arch Can Res. 4: 2, 2016.

131. Heidari, “Genomics and Proteomics Studies of Zolpidem, Nociceptin, Alpidem, Saricapten, Mireprofen, Zolimidine, Ofirprofene and Afabagin as Anti–Tumor, Peptide Antibiotics, Antiviral and Central Nervous System (CNS) Drugs”, J Data Mining Genomics & Proteomics 7: e125, 2016.

132. Heidari, “Pharmacogenomics and Pharmacoproteomics Studies of Phosphodiesterase–5 (PDE5) Inhibitors and Paclitaxel Albumin–Stabilized Nanoparticles as Sandwiched Anti–Cancer Nano Drugs between Two DNA/RNA Molecules of Human Cancer Cells”, J Pharmacogenomics Pharmacoproteomics 7: e153, 2016.

133. Heidari, “Biotranslational Medical and Biospectroscopic Studies of Cadmium Oxide (CdO) Nanoparticles–DNA/RNA Straight and Cycle Chain Complexes as Potential Anti–Viral, Anti–Tumor and Anti–Microbial Drugs: A Clinical Approach”, Tranl Biomed. 7: 2, 2016.

134. Heidari, “A Comparative Study on Simultaneous Determination and Separation of Adsorbed Cadmium Oxide (CdO) Nanoparticles on DNA/RNA of Human Cancer Cells Using Biospectroscopic Techniques and Dielectrophoresis (DEP) Method”, Arch Can Res. 4: 2, 2016.

135. Heidari, “Cheminformatics and System Chemistry of Cisplatin, Carboplatin, Nedaplatin, Oxaliplatin, Hexaplatin and Lobaplatin as Anti–Cancer Nano Drugs: A Combined Computational and Experimental Study”, J Inform Data Min 1: 3, 2016.

136. Heidari, “Linear and Non–Linear Quantitative Structure–Anti–Cancer–Activity Relationship (QSACAR) Study of Hydros Ruthenium (II) Oxide (Ru2O3) Nanoparticles as Non–Nucleoside Reverse Transcriptase Inhibitors (NNRTIs) and Anti–Cancer Nano Drugs”, J Integr Oncol 5: e10, 2016.

137. Heidari, “Synthesis, Characterization and Biospectroscopic Studies of Cadmium Oxide (CdO) Nanoparticles–Nucleic Acids Complexes Absence of Soluble Polymer as a Protective Agent Using Nucleic Acids Condensation and Solution Reduction Method”, J Nanosci Curr Res 1: e101, 2016.

138. Heidari, “Coplanarity and Collinearity of 4–Dimethyl–2,2–Bithiazole in One Domain of Blemycin and Pongyungyim to be Responsible for Binding of Cadmium Oxide (CdO) Nanoparticles to DNA/RNA Bidentate Ligands as Anti–Tumor Nano Drug”, J Int J Drug Dev & Res 8: 007–008, 2016.

139. Heidari, “A Pharmacovigilance Study on Linear and Non–Linear Quantitative Structure (Chromatographic) Retention Relationships (QSSR) Models for the Prediction of Retention Time of Anti–Cancer Nano Drugs under Sychronotron Radiations”, J Pharmacovigil 4: e161, 2016.

140. Heidari, “Nanotechnology in Preparation of Semipermeable Polymers”, J Adv Chem Eng 6: 157, 2016.

141. Heidari, “A Gastrointestinal Study on Linear and Non–Linear Quantitative Structure (Chromatographic) Retention Relationships (QSSR) Models for Analysis 5–Aminosaliclyates Nano Particles as Digestive System Nano Drugs under Sychronotron Radiations”, J Gastrointest Dig Syst 6: e119, 2016.

142. Heidari, “DNA/RNA Fragmentation and Cytolysis in Human Cancer Cells Treated with Diphphamide Nano Particles Derivatives”, Biomedical Data Mining 5: e102, 2016.

143. Heidari, “A Successful Strategy for the Prediction of Solubility in the Construction of Quantitative Structure–Activity Relationship (QSAR) and Quantitative Structure–
Heidari A (2020) Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted 'tubular' polar areas of magnetic fields and hassium nanoparticles through Tracking of Helium-4 Nucleus (Alpha Particle) Using Synchrotron Radiation", Arch Biotechnol Biomed. 1 (1): 067–0108, 2017.

Heidari, “Visualizing Metabolic Changes in Probing Human Cancer Cells and Tissues Metabolism Using Vivo 1H or Proton NMR „C/3N/MR „/P/NMR Spectroscopy and Self-Organizing Maps under Synchrotron Radiation”, SOJ Mater Sci Eng 5 (2): 1–6, 2017.

Heidari, “Cavity Ring-Down Spectroscopy (CRDS). Circular Dichroism Spectroscopy; Cold Vapour Atomic Fluorescence Spectroscopy and Correlation Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation”, Enliven: Challenges Cancer Detect Thr 4 (2): e001, 2017.

Heidari, “Laser Spectroscopy, Laser–Induced Breakdown Spectroscopy and Laser–Induced Plasma Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation”, Int J Hepat Gastroenterol, 3 (4): 079–084, 2017.

Heidari, “Time–Resolved Spectroscopy and Time–Stretch Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation”, Enliven: Pharmacovigilance and Drug Safety 4 (2): e001, 2017.

Heidari, “Overview of the Role of Vitamins in Reducing Negative Effect of Decapetol (Triprotenyl Acetate or Pamolate Salts) on Prostate Cancer Cells and Tissues in Prostate Cancer Treatment Process through Transformation of Malignant Prostate Tumors into Benign Prostate Tumors under Synchrotron Radiation”, Open J Anal Bioanal Chem 1 (1): 021–026, 2017.

Heidari, “Electron Phonemological Spectroscopy, Electron Paramagnetic Resonance (EPR) Spectroscopy and Electron Spin Resonance (ESR) Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation”, Austin J Anal Pharm Chem. 4 (3): 1091, 2017.

Heidari, “Therapeutic Nanomedicine Different High–Resolution Experimental Images and Computational Simulations for Human Brain Cancer Cells and Tissues Using Nanocarriers Deliver DNA/RNA to Brain Tumors under Synchrotron Radiation with the Passage of Time Using Mathematica and MATLAB”, Madridge J Nano Tech. Sci. 2 (2): 77–83, 2017.

Heidari, “A Consensus and Prospective Study on Restoring Cadmium Oxide (CdO) Nanoparticles Sensitivity in Recurrent Ovarian Cancer by Extending the Cadmium Oxide (CdO) Nanoparticles–Free Interval Using Synchrotron Radiation Therapy as Antibody–Drug Conjugate for the Treatment of Limited–Stage Small Cell Diverse Epithelial Cancers”, Cancer Clin Res Rep, 1: 2, e001, 2017.

Heidari, “A Novel and Modern Experimental Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under White Synchrotron Radiation”, Cancer Sci Res Open Access 4 (2): 1–8, 2017.

Heidari, “Different High–Resolution Simulations of Medical, Medicinal, Clinical, Pharmaceutical and Therapeutics Oncology of Human Breast Cancer Translational Nano Drugs Delivery Treatment Process under Synchrotron and X–Ray Radiations”, J Oral Cancer Res 1 (1): 12–17, 2017.

Heidari, “Vibrational Dechertz (Hz), Centhertz (cHz), Millihertz (mHz), Microhertz (μHz), Nanohertz (nHz), Femtohertz (fHz) and Zeptohertz (zHz) Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, International Journal of Biomedicine, 7 (4), 335–340, 2017.

Heidari, “Force Spectroscopy and Fluorescence Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation”, EC Cancer, 2 (5), 239–246, 2017.

Heidari, “Photoacoustic Spectroscopy, Photomission Spectroscopy and Photothermal Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation”, BAOU Cancer Res Ther, 3: 3, 045–052, 2017.

Heidari, “J–Spectroscopy, Exchange Spectroscopy (EXSY), Nuclear Overhauser Effect Spectroscopy (NOESY) and Total Correlation Spectroscopy (TOCSY) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, EMS Eng Sci J, 1 (2): 006–013, 2017.

Heidari, “Neutron Spin Echo Spectroscopy and Spin Noise Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation”, Int J Biopharm Sci, 1: 103–107, 2017.
Heidari A (2020) Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted ‘tubular’ polar areas of magnetic fields and hassium nanoparticles.
Heidari A (2020) Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted ‘tubular’ polar areas of magnetic fields and hassium nanoparticles

Dent Oral Maxillofac Res, 2020        doi: 10.15761/DOMR.1000340

305.

306. of magnetic fields and hassium nanoparticles

307.

308. Heidari A (2020) Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted ‘tubular’ polar areas

303.

304. Molecule C_{13}H_{20}BeLi_{2}

Initiation (EPPSI) Nano Molecules”

309.

310. Heidari, R. Gobato, M. R. R. Gobato, A. Heidari, A. Mitra,

311. “A Hypertension Approach to Thermal Infrared Spectroscopy (NOEST) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESET) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

312.

313. Comparing the Variety of Synchrotron, Synchrocyclotron and LASER Radiations and Their Roles and Applications in Human Cancer Cells, Tissues and Tumors Transformation Process to Benign Human Cancer Cells, Tissues and Tumors Using Cadmium Oxide (CdO) Nanoparticles”

314.

315. “The Importance of Attenuated Total Reflectance

316. Heidari, J. Esposito, A. Caissutti,

317. “The Quantum Entanglement Dynamics Induced by Non-Linear Interaction between a Moring Nano Molecule and a Two–Mode Field with Two-Photon Transitions Using Reduced Von Neumann Entropy and Jaynes–Cummings Model for Human Cancer Cells, Tissues and Tumors Diagnosis”, Int J Crit Care Emerg Med 5 (2): 071–084, 2019.

318.

319. Heidari, J. Esposito, A. Caissutti,

320. “A Hypertension Approach to Thermal Infrared Spectroscopy (NOEST) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESET) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

321.

322. Heidari A, “A Modern and Comprehensive Investigation of Inelastic Electron Tunneling Spectroscopy (IETS) and Scanning Tunneling Spectroscopy on Malignant and Benign Human Cancer Cells, Tissues and Tumors through Optimizing Synchrotron Microbeam Radiotherapy for Human Cancer Treatments and Diagnostics: An Experimental Biospectroscopic Comparative Study”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

323. Heidari, “A Novel and Comprehensive Study on Manufacturing and Fabrication Nanoparticles Methods and Techniques for Processing Cadmium Oxide (CdO) Nanoparticles Colloidal Solution”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

324. Heidari, “A Combined Experimental and Computational Study on the Catalytic Effect of Aluminum Nitride Nanoacid Cat (AlN) on the Polymerization of Benzene, Naphthalene, Anthracene, Phenanthrene, Chrysene and Tetracene”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

325. Heidari, “Novel Experimental and Three-Dimensional (3D) Multiphysics Computational Framework of Michaelis–Menten Kinetics for Catalyst Processes Innovation, Characterization and Carrier Applications”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

326. Heidari, “The Hydrolysis Constants of Copper (I) (Cu+) and Copper (II) (Cu2+) in Aqueous Solution as a Function of pH Using a Combination of pH Measurement and Biospectroscopic Methods and Techniques”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

327. Heidari, R. Gobato, M. R. R. Gobato, A. Heidari, “A Hypertension Approach to Thermal Infrared Spectroscopy (NOEST) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESET) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

328. Heidari A, “The Quantum Entanglement Dynamics Induced by Non-Linear Interaction between a Moring Nano Molecule and a Two–Mode Field with Two-Photon Transitions Using Reduced Von Neumann Entropy and Jaynes–Cummings Model for Human Cancer Cells, Tissues and Tumors Diagnosis”, Int J Crit Care Emerg Med 5 (2): 071–084, 2019.

329. Heidari, J. Esposito, A. Caissutti,

330. “The Quantum Entanglement Dynamics Induced by Non-Linear Interaction between a Moring Nano Molecule and a Two–Mode Field with Two-Photon Transitions Using Reduced Von Neumann Entropy and Jaynes–Cummings Model for Human Cancer Cells, Tissues and Tumors Diagnosis”, Int J Crit Care Emerg Med 5 (2): 071–084, 2019.

331. Heidari, J. Esposito, A. Caissutti,

332. “A Hypertension Approach to Thermal Infrared Spectroscopy (NOEST) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESET) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

333. Heidari, R. Gobato, M. R. R. Gobato, A. Heidari, “A Hypertension Approach to Thermal Infrared Spectroscopy (NOEST) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESET) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

334. Heidari A, “A Modern and Comprehensive Investigation of Inelastic Electron Tunneling Spectroscopy (IETS) and Scanning Tunneling Spectroscopy on Malignant and Benign Human Cancer Cells, Tissues and Tumors through Optimizing Synchrotron Microbeam Radiotherapy for Human Cancer Treatments and Diagnostics: An Experimental Biospectroscopic Comparative Study”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

335. Heidari, “A Novel and Comprehensive Study on Manufacturing and Fabrication Nanoparticles Methods and Techniques for Processing Cadmium Oxide (CdO) Nanoparticles Colloidal Solution”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

336. Heidari, “A Combined Experimental and Computational Study on the Catalytic Effect of Aluminum Nitride Nanoacid Cat (AlN) on the Polymerization of Benzene, Naphthalene, Anthracene, Phenanthrene, Chrysene and Tetracene”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

337. Heidari, “Novel Experimental and Three-Dimensional (3D) Multiphysics Computational Framework of Michaelis–Menten Kinetics for Catalyst Processes Innovation, Characterization and Carrier Applications”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

338. Heidari, “The Hydrolysis Constants of Copper (I) (Cu+) and Copper (II) (Cu2+) in Aqueous Solution as a Function of pH Using a Combination of pH Measurement and Biospectroscopic Methods and Techniques”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

339. Heidari, R. Gobato, M. R. R. Gobato, A. Heidari, “A Hypertension Approach to Thermal Infrared Spectroscopy (NOEST) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESET) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

340. Heidari A, “The Quantum Entanglement Dynamics Induced by Non-Linear Interaction between a Moring Nano Molecule and a Two–Mode Field with Two-Photon Transitions Using Reduced Von Neumann Entropy and Jaynes–Cummings Model for Human Cancer Cells, Tissues and Tumors Diagnosis”, Int J Crit Care Emerg Med 5 (2): 071–084, 2019.

341. Heidari, J. Esposito, A. Caissutti,

342. “The Quantum Entanglement Dynamics Induced by Non-Linear Interaction between a Moring Nano Molecule and a Two–Mode Field with Two-Photon Transitions Using Reduced Von Neumann Entropy and Jaynes–Cummings Model for Human Cancer Cells, Tissues and Tumors Diagnosis”, Int J Crit Care Emerg Med 5 (2): 071–084, 2019.

343. Heidari, J. Esposito, A. Caissutti,

344. “A Hypertension Approach to Thermal Infrared Spectroscopy (NOEST) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESET) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

345. Heidari A, “A Modern and Comprehensive Investigation of Inelastic Electron Tunneling Spectroscopy (IETS) and Scanning Tunneling Spectroscopy on Malignant and Benign Human Cancer Cells, Tissues and Tumors through Optimizing Synchrotron Microbeam Radiotherapy for Human Cancer Treatments and Diagnostics: An Experimental Biospectroscopic Comparative Study”, Glob Imaging Insights, Volume 3 (6): 1–8, 2018.

346. Heidari, “A Novel and Comprehensive Study on Manufacturing and Fabrication Nanoparticles Methods and Techniques for Processing Cadmium Oxide (CdO) Nanoparticles Colloidal Solution”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

347. Heidari, “A Combined Experimental and Computational Study on the Catalytic Effect of Aluminum Nitride Nanoacid Cat (AlN) on the Polymerization of Benzene, Naphthalene, Anthracene, Phenanthrene, Chrysene and Tetracene”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.

348. Heidari, “Novel Experimental and Three-Dimensional (3D) Multiphysics Computational Framework of Michaelis–Menten Kinetics for Catalyst Processes Innovation, Characterization and Carrier Applications”, Glob Imaging Insights, Volume 4 (1): 1–8, 2019.
Heidari A (2020) Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted 'tubular' polar areas of magnetic fields and hassium nanoparticles
Heidari A (2020) Lorenz gauge, electric and magnetic fields study of interaction of gravitationally accelerating ions through the super contorted 'tubular' polar areas of magnetic fields and hassium nanoparticles

Various Chain Length", Acta Chemica Malaysia (ACMY), VOLUME 3, ISSUE 2, Pages 39–60, 2019.

470. Heidari, K. Schmitt, M. Henderson, E. Besana, “A Chemical Review on Cancer Immunology and Immunodeficiency”, International Journal of Advanced Chemistry, Vol. 8, No. 1, Pages 27–43, 2020.

471. Heidari, V. Peterson, “A Comprehensive Review on Functional Roles of Cancerous Immunoglobulins and Potential Applications in Cancer Immunodiagnostics and Immunotherapy”, International Journal of Advanced Chemistry, Vol. 8, No. 1, Pages 44–58, 2020.

472. Heidari, V. Peterson, “An Encyclopedic Review on Stereotactic Hypofractionated Radiotherapy, Re–Irradiation and Cancer Genome Research”, International Journal of Advanced Chemistry, Vol. 8, No. 1, Pages 59–74, 2020.

473. Heidari, V. Peterson, “A Pervasive Review on Biomarker in Cervical Intraepithelial Lesions and Carcinoma”, International Journal of Advanced Chemistry, Vol. 8, No. 1, Pages 75–88, 2020.

474. Heidari, “Future Advanced Study of Thin Layers of DNA/RNA Hybrid Molecule Nanostructure”, J Mol Nanot Nanom 2 (1): 110, 2020.

Copyright: ©2020 Heidari A. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.