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When a Particle is really a Cluster, a Dispersion a Suspension and there is no Colloid is in sight, you have the recipe for Colloidal Silver that is not a Colloid either

Hans Laroo

Private and Independent researcher, Australia

***Corresponding Author:** Hans Laroo, E-mail: hlaroo@bigpond.com. Phone: 617 3202 3767

Citation: Hans Laroo (2016). When a Particle is really a Cluster, a Dispersion a Suspension and there is no Colloid is in sight, you have the recipe for Colloidal Silver that is not a Colloid either Int J Nano Med & Eng. 1:2 50-56

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Received October 28, 2016; **Accepted** November 2, 2016; **Published** November 05, 2016

Abstract

Little headway has been made for the past eighty years, but with the rise of infectious diseases immune to most of our arsenal of antibiotics, alternative and less vulnerable strategies have to be found. Accordingly the race is on to find a formidable adversary capable of eradicating the so-called biofilm protected bacterial colonies that are on the increase. Strangely enough the material most likely to have any chance of success has been banned by the Australian Government in 2003. This Legislation, enacted by the Therapeutic Goods Act (TGA) prohibits the so-called colloidal silver to be advertised and/or recommended as a medicine. Instead the only reference that can be made about this material is to name it "TREATED WATER". The reason for the introduction of this Legislation lies clearly in the domain of that part of the scientific community not having bothered to create standards and clarity as to what actually constitutes nanometre sized atomic silver clusters in suspension.

My research into so-called colloidal silver started in 2008. After substantial trials and experimentation, the findings are that almost no-one knows what really constitutes this liquid derivative of metallic silver. Other than flawed trials in vitro there is still no clear picture if this so-called colloidal silver is a friend or foe. Likewise, if it can actually deal with dangerous pathogens or not and how it actually works. The most likely reason for the lack of progress over all of these years is the misapprehension, thinking of it as being part of chemistry and not physics. The facts are now out, so called dispersions of colloidal silver are better named "nanometre sized atomic silver clusters in (an electrical) suspension. In addition the material can actually be produced with nothing more than pure silver, pure water, pure electricity and pure light at 420nm.

It is the purpose of this paper to explain that the science for both the production and its ability to (indiscriminately) kill pathogens is by way of the world of Quantum Physics. No longer can this Quantum Silver ever be referred to as a medicine but instead adopted as an instrument and a silver instrument at that, using a combination of quantum electrocution and blue shifted ultraviolet light. Also included in this presentation are details on alternative instrumentation for use in liquid nanotechnology in general.

Keywords : quantum physics, nanometre sized atomic silver clusters, capacitive reactance testing and linear cross polarisation strategies

INTRODUCTION

The chaos that chemistry scientists in the 20th Century have created, was the intrinsic use of reducing (caustic) Silver nitrate with more chemistry by some, the use of pulverised bulk metallic silver dumped in water, high voltage ablation and a flawed way of using electro-chemistry by producing silver products in broad daylight. In fact, ionic silver can only be reduced to neutral silver clusters when the light source has an energy level of at least 2.6eV.

This occurs at around 420nm, just like in the exposure of Black & White film emulsions using Silver halides. This particular process, should technically be referred to as electro-photochemistry. It occurs in complete darkness with only a narrow and almost monographic light, under refrigerated conditions and the hereby created silver ions that are simultaneous reduced to neutral silver as collections of nanosized atomic silver clusters at around

5nm. Reducing the wavelength of the light would create smaller clusters, whilst red shifts would make them larger. Exposure of small clusters to visible light and heat will cause aggregation into ever larger clusters until gravitational forces take over. There is no cleaner and simpler way of production. It is stable for years and does not consist of smaller and larger clusters needing separation and sorting by expensive ultra-centrifugation equipment. It is just a matter of switching on and off a voltage stabilised, current limited power supply. Naturally as always 'The Devil is in the detail'. Instead of keeping it simple (KIS), for decades others have sought out ways of producing 'pretend' colloidal silver that generally produced more ionic material than anything else. Uses of electrolysis by using salt to stimulate current flow, high voltage ablation up to 200,000 volt and the perpetual use of Silver nitrate and pulverised silver from the bulk metal, has left a legacy of nonsense and dangerous chemistry for others to ingest. Even today in the year 2016, very few scientists have any idea why nanometre sized silver (particles) kill indiscriminately most pathogens, not unlike antibiotics 'in vitro', but have even less of an idea, what happens inside the body 'in vivo'. Some of the scientists I associate with are taking the safer way out, and conduct their clinical trials topically on the skin and in the mouth.

Science is now in the 21st Century and our fascination with Alchemy from the Dark Ages has to be abandoned. Instead we should embrace Quantum reality and seek for answers in the realm of nano and pico dimensioned material and start taking control by taking steps to improve the entire technical and scientific concept of what really constitutes the truth in the following areas:

1. The use of accurate wording to describe all aspects of pico and nano technology, including manufacture, quality testing and preservation.
2. Write technical and scientific papers and precisely identify the materials used so that no confusion reigns as to what is the subject of the research.
3. Precisely engineer pico and nano technology for adaptation into the realm of Quantum physics. This is as evidenced by these small entities of silver no longer being subject to the laws of Classical Physics such as gravity. Instead their attributes of quantum confined electrons and local plasmon resonances that in some circumstances blue shift into areas of increased energy, even Ultraviolet. should be official be researched and conformed..
4. Clinical trials and experimentation to be run with authority and control in a genuine endeavour to embrace "Science – The search for evidence". Referring to this material by the mundane descriptions as AgNPs is not the way to go!
5. Draft local and international standards for adoption by all involved in the Industry and Science of Nanotechnology's Interfacial and Colloidal science. A suitable concept of this will be included in this paper.

WHAT EXACTLY IS COLLOIDAL SILVER?

Most colloidal silver is not. There are a number of reasons for that, both technically and literally.

(a) Literally: Colloidal silver should be just that: nothing else but nanometre sized silver. Generally, most pretend colloidal silver consists for the most part of ionic silver. This material is totally dissolved in the water and cannot be see. It can only able measured as a dissolved solid. Pure silver colloids are hydrophobic (water hating) and can be observed by any spectral light that it scatters.

(b) Technically: Pure colloidal silver at nanometre size and produced by electro-photochemistry and does not contain ionic silver. It is neither a colloid nor a dispersion. Instead it should be described as a collection of neutral silver atoms that have formed local clusters from around 10nm and smaller. They are produced between two silver electrodes immersed for the most part in water. For that reason they are not a dispersion in the true sense but instead in a state of static electrical suspension. Also they are unlike most colloids such as milk and toothpaste, long recognised as colloids.

The Dictionary of Colloid and Interface Science by Laurier L. Schramm lists the following conditions as colloids: fog, cloud, drizzle, rain, emulsions, aerosols and fine clay to quartz grit and gravel. Also Colloidal: A state of subdivision in which particles, droplets, or bubbles dispersed in another phase have at least one dimension between approximately 1 and 1,000nm, and in Colloidal dispersion, a system in which colloidal species are dispersed in a continuous phase of different composition or state.

What distinguishes nanometre sized silver clusters from other material is its metal origin. It is no longer subject to recognisable properties of Classical Physics, but instead displays quantum properties such as containing quantum confined electrons, no longer effected by gravity, in semi-permanent electrical suspension (Zeta potential) and displaying Local Plasmon Resonances. In addition to that it also possesses photo-electric properties with the ability to blue-shift incoming wavelengths of incident light of a lower frequency. A further argument to name the material Quantum Silver is its origin, and explained as follows:

During the initial electro-photochemical process, bulk silver is extracted atom by atom from the silver anode by current flow from the cathode. In this process the atoms lose their unpaired valence electron, and by doing so become silver ions. The valence electron remains in the water as a hydrated or solvated electron held captive by the dipolar nature of the water molecules. Normally the second phase will cause the silver cations to be attracted by the cathode, but for the simultaneous irradiation by violet light photons colliding with the hydrated electrons. Energy from the photons is transferred by forming a virtual particle called a photo-electron. This provides an escape and a place back in the silver cation that instantly converts to a neutral silver atom that requires binding to another neutral silver atom and form a dimer for stability. It is thus a case of temporarily removing an electron from metallic silver and then returning it again. Manipulations like that inside atoms are by definition 'quantum physics'.

Conclusion: Quantum silver is thus not a colloid nor a colloidal dispersion and does not consist of particles either. Rather Quantum Silver consists of atoms that form clusters in water, by way of each atom donating its outer electron as valence bonding of the cluster. The surrounding water molecules orientate their hydrogen atoms (positive charges) toward the outer valence electrons (negative charges) in order to neutralise their immediate surroundings. The optimum wavelength for production has been found experimentally to be between 417 – 420nm where water becomes super transparent and not absorbing.

Note! Most of what is written here has been substantiated by research and experimentation. Yet many other aspects of quantum Silver are still to be investigated:

- (a) The wavelength of the incident irradiating light (violet and shorter) rendering the ionic silver neutral (photo reduction or Photo-electron transfer) appears related to cluster size.
- (b) Quantum silver kills pathogens by a form of electron originating electrocution coming from the bonding valence electrons in the

skin-depth area of the silver clusters. It shares this property with the bulk silver and two other metals, copper and gold. Copper has an unpaired electron in the fourth shell, Silver in the fifth shell and gold in the sixth shell. In addition, silver clusters at very small nanometre sizes have an astronomical ratio of surface area to mass volume. So irrespective what to call the mechanism, an antiseptic, a biocide, a bioactive property, it is actually a form of electrocution at an extremely small scale.

The most likely reason and/or cause for everyone involved in what is generally known as colloidal silver, would be scientific ignorance as to what this material actually is. Often patent rights are involved and proper identification of its characterisation are kept secret. All the more reason to set a standard to avoid poisoning others, oneself and loved ones too! Silver is a transitional metal and we must not lose sight of that.

Some interesting information about toxicity levels has just been located in 'Organic and Whole foods' on the subject of drinkable water, it states the following:

Permissible amounts of chemical substances in natural mineral water (valid in Germany from 1990)

Substance	Permissible amount in mg/l (or ppm)
Arsenic	0.05
Cadmium	0.005
Chromium	0.05
Mercury	0.001
Nickel	0.05
Lead	0.05
Antimony	0.01
Selenic	0.01
Borate	30.
Barium	1.

Native silver is found in two variations of safe silver isotopes in an almost 50/50 ratio and dependent where in the world silver it is found and mined with a host of other elements. These are on the average lead, copper, iron, arsenic and many others in a variety of ratios. Purifying silver does substantially minimise these unwanted and often dangerous contaminants. Using silver to a purity of 99.998 to 99.999 and reducing the concentration to less than 10ppm, is known to reduce arsenic content to a safe value of about 10ppb. There is no doubt that to adopt similar safeguards of permissible amounts of dangerous contaminants in so-called colloidal silver as well would be a prudent and common sense decision to make.

There are many scientific papers related to mostly clinical trials and only relative few discussing the aspects of physics for silver. Unfortunate, neither of the two groups ever identify the type of silver solution that has been used. With some university

laboratories no doubt using Silver nitrate, others I checked up on had purchased pulverised silver and yet others again had purchased something without knowing exactly what it is they bought, i.e. only identified as AgNPs. For these reasons alone it is time to start thinking of working toward a standard. Science is supposed to be a search for evidence, but if the subject material cannot be properly identified, any discoveries should be considered flawed. In most of these papers also, colloidal silver, for want of a better name, is never treated alone. Always there is 'other chemistry' involved, including capping agents. Perhaps the silver products are unstable, making accurate testing impossible. To get the ball rolling, I suggest the following trajectory, considerations and priorities:

1. The type of manufacturing/production and concentration. From my perspective, only simultaneous oxidation and reduction by electro-photochemistry must be adopted. This is accomplished with precise current limiting high voltage (300 to 600 volts DC),

under refrigerated conditions (4 to 100 C) and using 420nm LED light source. This procedure is able to produce consistent batches of small clusters in a narrow distribution. Sizes are approximately between 3 and 10nm, peaking between 5 and 7nm. Concentration also is very important in connection with MIC requirements (Minimum inhibitory Concentration). Even more important is "What is the material going to be used for?" Since standard dilution practices are counter-productive for suspended silver clusters, it would be prudent to produce batches of specific concentrations at various concentrations, i.e. 5ppm, 10ppm, 15ppm and so on. The present and rising threat of biofilm protected species and the failing of existing antibiotics, may dictate which way to go.

2. Determination of cluster size and shape. The secret of long-term stability is producing the smallest possible clusters with the argument that it takes longer for a very small nanocluster to increase in size by aggregation, e.g. from 3nm to an ineffective 40nm, as compared to a 20nm size. Keeping cluster, sizes below 10nm and the concentration low at 5ppm, clusters are bound to be spherical. In addition with an astronomical surface to mass ratio and a high minus voltage repulsive Zeta potential it is able to present a formidable area to its environment and get up very close due to its small size.

3. Declaration as to its purity and percentage of its contaminants and what those contaminants are. As stated earlier, the product may contain dangerous substances at high percentages, such as lead and arsenic beyond what is allowed by Law. By many producers and users this aspect of silver is hardly ever considered.

4. General requirements. There will be a need for handling and storage such as keeping the material refrigerated, which is no different than what we do with our food as well as providing protection from environmental conditions. In addition there should be the availability of a Safety Data Sheet and information as to its 'Use by Date'.

5. Its use as an antiseptic. Insufficient data is available on how nano silver material reacts inside our bodies (in vivo), when even studies with this material in a petri dish (in vitro) is inconclusive due to the complete absence of a standard. Any such results so far are considered flawed for obvious reasons. "Better being safe than sorry". For that reason only topical applications should be considered.

NOMENCLATURE (the proper wording and descriptions for scientific and technical expression):

There is presently no formal agreement anywhere related to nanometre sized silver clusters on how to describe the material. Instead confusing descriptions are used such as AgNPs, Colloidal silver that may be more ionic silver, hydrosol etc. that defy explanation as to its true nature. Using buzz words in scientific research is demeaning and highly suspect and should be avoided. Instead it will be recommended to introduce standard concepts and terminology that everyone understands. Naming colloidal silver by its proper description is a step in the right direction.

CONCLUSION

The way forward is by understanding. Especially those doing research and clinical trials into all facets of nanometre sized collections of atomic silver clusters I refer to this as Quantum Silver for lack of a better description. There are many areas waiting to be discovered and I will be doing further research, investigation and experimentation in the following areas:

1. A study into the effect of longwave incident light on the silver atoms a part of a cluster and the reaction at the surface of a Local Plasmon resonance. Since the wavelength of the incident photon may be at 600nm for example, the atomic cluster and even the atoms are much smaller and cannot accommodate this. However the incident photon only causes an electron at the so-called 'skin depth' to vibrate and oscillate. When the oscillation stops, in some cases the departing photon has an increased in energy level. This secondary emission can be detected and measured with the combined abilities of a modified spectrophotometer and a high gain Night vision Device (NVD). This is planned for the coming months.

2. Introducing standards also brings a need for appropriate test instrumentation at affordable prices and capable of determining the properties of the silver material and the aqueous media. Also its properties such as cluster size, Zeta potential and foremost the concentration. For some time now I have designed and constructed a small number of prototype instruments capable of doing just that. These experimental instruments are listed hereunder:

(a) A Linear Cross polarising and light scattering Spectrophotometer. It is capable of tuning out materials with a refractive index in the visible spectrum so that the light scattering from the silver can be quantified. In addition, it will be able to ascertain the instrument is quantifying silver by its absorbance properties at around 420nm.

(b) An analogue capacitance reactance instrument that is capable of measuring the concentration of just the suspended silver in ppm by the increase in capacitance reactance from in pico farads to nano farads in ppm or mg/l. An ICP-MS would have great difficulty with such quantifying, as it would measure all of the silver in all forms including the ionic state.

(c) A third instrument that has been in use for some time now, has proven quite valuable. It is also analogue technology based and is used for water purity testing. So far it appears quite tolerant to changes in temperature and the probe using silver sensors does not require the constant use of buffer solutions. Readings are immediately and pure deionised commercial grade water reads between 1 and 4 on a 100 scale. Tap water however gives readings from 70 to 90 on a scale of 100. It has an input resistance of 10,000 million Ohm (10KM Ohm) and the voltage on the probe is below the equilibrium voltage of water (1.23 volt) and thus incapable of breaking up the water molecules into its constituent gasses, Hydrogen and Oxygen.

(d) The testing of suspended materials taken out of their aqueous media changes the properties of the now dehydrated material

irreversibly. For that reason it is recommended to study nano metre sized material in its natural media wet. Whilst a number of possibilities were considered, a concept called: “micro shadow casting analysis coupled with a deviation of the Foucault optical test has been started on. The basic principle behind this is:

(a) A shadow gets smaller when the light source is distant and larger when the light source is close-up, and (b) the original Foucault test is able to see optical unevenness a curved surface as small as one millionth of an inch. However because such tests were conducted with incandescent light globes, introducing short

wavelength light (green or blue) from a laser diode is likely to provide a higher resolution. This is particularly important with nanometre sized entities.

For the benefit of mass production, I have also designed and constructed several multi-channel silver generators that can increase production 24 times faster as well as 72 times faster, without compromising quality and purity. Testing on its proper operation is happening soon.

Final comment: The properties of nano sized silver at 10nm or below are quite extraordinary for use as an unusual antiseptic as well as for more efficient form of solar energy harvesting.

Colloidal Nano Silver – Its Production Method, Properties, Standards and its Bio-efficacy as an Inorganic Antibiotic, by Hans Laroo, Published by OMIC Publishing, Physical Chemistry & Biophysics 2013

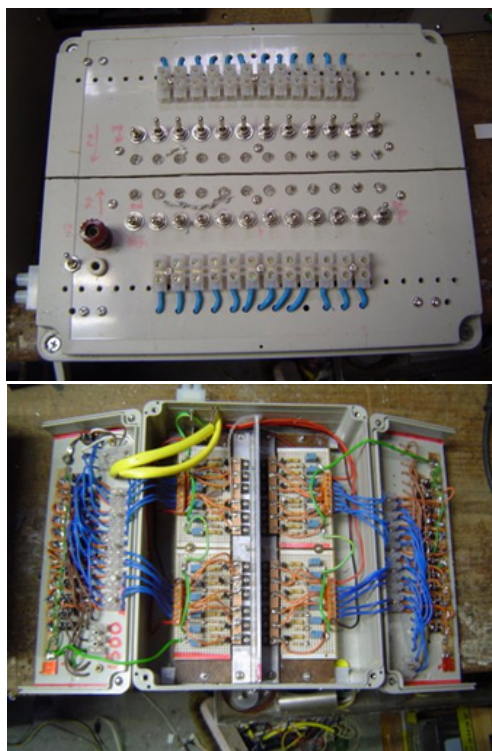
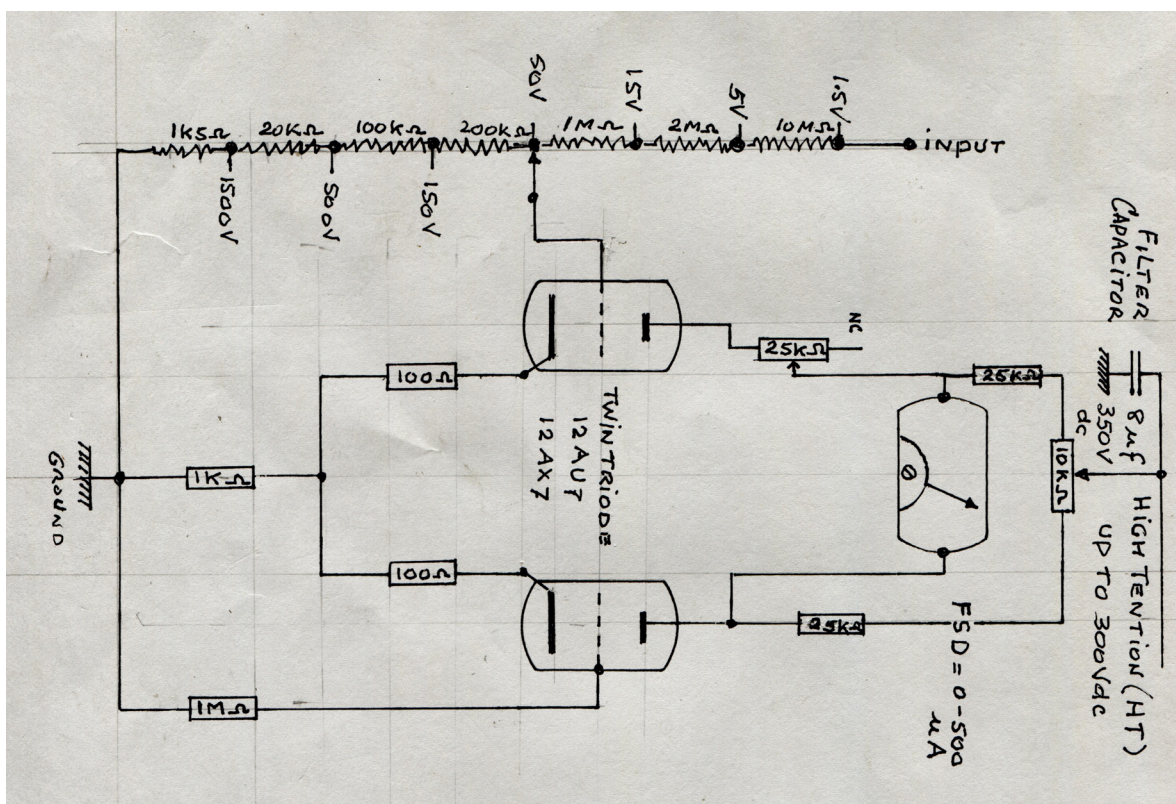


Illustration of a typical 24 channel distribution current limiting generator for increased colloidal silver production twenty four times faster. It does this without compromising quality. Voltage potential and current limiting control are adjusted for a 1% tolerance. Normally electrical parallel circuits suffer from so-called ‘current hugging’ which means that some circuits draw more than the others. This system is immune from that. See closed box with output terminals to electrodes and the actual circuit components inside that regulate everything. Pictures of both a closed case as well as an open case showing components



Illustration of a typical vacuum tube voltmeter. Please note that the values increase to the right and diminish toward the left in an opposite way to conventional analogue multimeters. To the far right is the maximum value of 1,000 million Ohm shown.



This is a rough idea of what a basic electronic circuit of a Vacuum Tube Voltmeter or VTVM for short. It consists basically of a HT power supply and a low ac voltage of 12.6 volts ($2 \times 6.3\text{V}$), a twin triode vacuum valve, a 500 micro ampere (500 μA) panel meter and variable resistor for biasing and other resistors, some of which are used as a voltage divider. The reader will note that compared to a transistor voltmeter with an average impedance at the input of 10 kilo Ohm, the vacuum tube can offer an impedance at least a hundred times higher. This is due to the fact that between the grid (small dashed lines and the plate at the top of valve, there is no actual physical connection.

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