

## **The Variety of Optical and Electronic Effects related to the testing of Nanometre sized suspended Silver.**

### **Abstract:**

*It is our view that a combination of analogue optical and electronic technologies and even on their own are more than capable of determining and analysing the various properties of pure water as well as pure water containing pico and nanometre sized atomic silver clusters. With (low cost) operational amplifiers having been available that operate at very low DC voltages and their ability to convert current into a resistance or voltage or in the reverse, depending on the use of an inverting or non-inverting input should make it easy to construct affordable equipment. These operational amplifiers also boast extremely high input resistances in the Tera Ohm range ( $10^{12}$ ). That is a million, million Ohm input resistance! With the additional availability of discrete solid state devices such as transistors, capacitors, resistors and integrated circuits (ICs) even available as tiny surface mount varieties, there is nothing to stop us from producing appropriate electronic equipment. It is with same ease that we can build optical equipment in combination with electronics in order to observe the various optical properties and their effects associated with water and quantum silver. Some of these optical effects are the Photo-electric effect (Einstein 1909), plasmon and local Plasmon resonances. Polaritons and blue shifted secondary emissions caused by photonic release of quantum confined electrons.*

**Keywords:** Photo-electric effect, Local Plasmon Resonances (LPRs), Blue-shifting, Ohm's Law, quantum silver and Conductivity.

### **Introduction to relevant electronic effects:**

**Note!** There are many misconceptions in electronics, especially with Direct Current and Alternating current. As a simple explanation on the difference of the two, direct current comes from a battery or alternatively as a rectified direct current from an alternating current and voltage supply. An alternating current in most cases is a sine wave. In the case of mains power for our house, it is either a 50Hz sinewave at 240 volt AC, 60Hz sinewave at 110 volt AC or something similar. If a full wave bridge rectifier is used to rectify 240 volt AC, a multiplier factor of 1.4 X is used to provide a direct current voltage of 336 volt DC, i.e.  $240 \times 1.4 = 336$ . However that can only apply if the system is loaded with filtering capacitors for stability.

The second aspect of Direct Current as used in electrochemistry for producing quantum silver is that it is as constant as we can imagine it. Alternating current on the other hand is constantly fluctuating between a positive and negative state, moving through a position of zero voltage and current in that process. That being the case, it begs the question, "Why use alternating current (and voltage) for measuring direct current and giving it the name '*conductivity*'?"

### **The use of *conductivity* measurement:**

The most established order in electronics, and the relationship between current, voltage and resistance is found in Ohm's Law, formulated by German Physicist, George Simon Ohm hundreds of

years ago. He stated that “The amount of current flowing in a circuit with a constant resistance is directly proportional to the electromotive force on the circuit and inversely proportional to the total resistance of the circuit, i.e. an increase in voltage across a fixed resistance, produces a directly proportional rise in current. As an example this means that a potential of 1 volt (E or V) across a resistance of 1 Ohm (R) will allow 1 ampere of current (I) to flow. It would also dissipate 1 watt of power in Watts (W). Three simple calculations can show the relationship conditions of voltage:  
Current: Resistance as follows:

**Resistance = Voltage divided by current**

**Current = Voltage divided by Resistance**

**Voltage = current multiplied by resistance.**

All of this is relevant to Direct Current only, as alternating current introduces completely different factors such as IMPEDANCE, an AC resistance that varies with frequency. High impedances at low frequencies and low impedances at high frequencies. To produce conductivity meters at different operating frequencies also means that the results between such differing conductivity meters can never be truly compared.

It all started with the perceived lack of ability to produce precise very low current and very high resistance input in order to measure low values of current (nano and pico meters) and high input resistance meters. Unfortunately it was only a perception as that technology was already known. Nevertheless chemists decided that current and Ohmic resistance were out and the concept of DC MHO and DC Conductivity were in. However there was a flaw caused by the equilibrium voltage of water to which this equipment was supposed to work on. This voltage is 1.23 volt DC and when exceeded, water decomposes into its constituents of Oxygen and Hydrogen and thus polarises. That would make accurate measurements impossible. Instead of lowering the applied voltage on the probe to a value below this equilibrium voltage of water to 1 volt DC or even less, AC conductivity was introduced! It is ironic, that instead of fixing the problems, it only got worse. It is simply not possible to measure current by way of AC conductivity and measure its DC reciprocal in resistivity at the same time with the one instrument, irrespective if you bring distance factor into it or not. This is where matters stand at the moment. It is also most likely the reason why the influence of the voltage factor was never made part of this equation. There is a website in the internet that has made an attempt to overcome some of these difficulties by introducing inverse proportional values between conductivity and resistivity by way of a chart that ranges from 1 Ohm to 100 million Ohm. Somewhere in the middle are the figures of the most appropriate conductivity level applicable to pure water and starting at 1 million Ohm as the reciprocal of 1 micro (1/millionth) Siemens. From that can be seen that 10 million Ohm = 0.1 micro Siemens and 100 million Ohm = 0.01 micro Siemens in an ever decreasing conductivity for ever purer water referred to as ultra-pure. An increase of conductivity is expressed as being 100.000 Ohm (or 100KOhm) being the reciprocal of 10 micro Siemens, etc. all of that toward 1 Ohm at the bottom end of extreme levels of conductivity. No mention is ever been seen on the actual impedance factor on AC conductivity meters as if it is totally technically irrelevant.

***More of concern than all of the flawed aspects of conductivity measurements, even the lack of verification that 1 micro Siemens is the reciprocal of 1 million Ohm resistivity, is the seemingly forgotten undissolved solids in the water that carry no charge. These***

***undissolved or immersed neutral solids could be anything at all, even heavy metals or dangerous pathogens.***

**Other electronic effects: such as hydrated electrons, parallel resistance factors and quantum confined electrons.**

#### **Hydrated electrons.**

Until recently and also known as solvated electrons, hydrated electrons were considered an oddity, but in the case of so-called colloidal silver production, the oxidative process of ionic silver and the loss of the outer (unpaired) electron that temporarily winds up in the water and held captive there, there must be many. In addition the constantly breaking up and reconnecting of hydrogen bonds, many electrons in that process must also be temporarily free and hydrated. They can remain that way due to the orientation of positively charged hydrogen ions around free electrons in the water. This could account for unexpected influences in conductivity levels. Only photons with elevated levels in electron volts (eV) are able to release these hydrated electrons provide there is a destination available.

#### **Parallel resistance factors.**

Place two equal value resistors parallel, such as two resistors of 1,000 Ohm or 1KOhm, and the combined resistance will be only 500 Ohm. Place these resistors in series and the combined resistance will be 2,000 Ohm. With capacitors it is the other way around. In a parallel configuration the capacitive factor will double and in series measure only half. This principle of parallel resistance also effects the loading placed by the measuring instrument. An example would be trying to measure the resistance of water presumed to be 100 million Ohm with a multimeter digital or analogue with an internal input resistance of 10 million Ohm. The actual measurement would be a small fraction less than 10 million ohm as if the resistance of water at 100 million ohm does not even exist. In the 1900s this fact was well known and the usual remedy was to use a meter that had an internal input resistance of at least 100 times larger than the highest resistance encountered in electronics in commercial equipment. Hence the introduction of the VTVM or vacuum Tube Voltmeter with in input resistance able to measure 1,000 million Ohm. A very small loading indeed and a relatively accurate reading of a 10 million Ohm resistor.

#### **Quantum confined electrons.**

In order to understand quantum confined electrons, we have to define electrons that are not. In metallic conductors, electrons carrying current under the influence of a voltage potential are relatively free to move. That is particularly the case with silver. Of all metallic conductors including copper and gold, silver stands out as the most efficient conductor of electrons and heat. However that is not so when atomic silver clusters are reduced to just a few nano metres in size. In such a situation there is no free movement such as in bulk metal but quantum limited in their confined space. This brings with it additional stored energy, such as would be the case of a compressed spring. Releasing quantum confined electrons even with low intensity photonic energy would normally be absorbed and re-emitted at a lower energy level. There are mostly always energy losses during such transitions. It is called red-shifting. However with the release of quantum confined electrons in silver, such low energy incident light can actually increase in energy and cause a blue-shift. This phenomena occurs with Local Plasmon Resonances, i.e. a collision between a low energy photon and an electron in the outer skin of the silver atom. Just able to cause a thermal vibration

and a simultaneously short duration local oscillation, both the photonic energy and the electron involved cannot really be accommodated due to size restriction of nano sized silver, somehow are able to do so due to quantum physics and the subsequent re-emission of the photon is now blue-shifted. A higher energy level than before.

### **OPTICAL EFFECTS as used in analysing properties and other aspects of quantum silver.**

Aware of the fact that pico and nano metre sized cluster cannot directly be seen, even with a powerful optical microscopes, leaves science with only light-scattering options. Electron and scanning electron microscopes are able to magnify and resolve even smaller objects, it has to be dry however. To have it in a liquid form just does not work. Besides, quantum silver out of water is no longer the same substance and adding water later does not restore to material to its original condition either. So light scattering it will have to be. However there is nothing detrimental or subtle about light scattering techniques. It works very sufficiently as a proper physics science.

### **What exactly is light scattering?**

The best analogy of light scattering is a diffuse reflection of light. Light from a source like the sun or a lamp is referred to as incident light and when it falls on a surface, it is reflected light that is generally scattered in different directions by an available surface, especially an uneven surface. The angle of incidence can range from being perpendicular to the surface as one extreme form of reflection and scattering, including some back-scattering, as well as reflection scattering at almost 90 degrees to the perpendicular as the other extreme. Instead of scattering from a flat surface, scattering can also occur from a highly curved surface such as a laser light shining on a small ball bearing and scattering that light over a large angle. The smaller the ball bearing the greater the curvature (away from a flat surface) the wider will be the angle of the scatter. There may in fact come a point where the angle of reflective scattering is too wide to be picked up by a single sensing photo-sensor or photo-diode, in which case more than one need to be used.

Light scattering can be used with white light or with a very specific wavelength of light. If for instance a red light is used between 635-700nm, only large objects can reflect/scatter that light, but if the objects illuminated are too small, say 400nm, these photonic waves cannot be accommodated. Hence the use of light of different wavelengths can provide an indication as to the approximate size of the objects. However we have to be very careful with making assumptions as this practice may suit spherical particles (same size all around) compared to oblong particles having one dimension one way and another larger dimension crossways.

### **The Tyndall effect.**

Many confuse light scattering with the Tyndall effect, which is a physical phenomenon caused by light coming through a very small aperture into a liquid containing undissolved fine particles and spreading out in a cone format. The reverse happens when too much incident light is used such as from an arc welder and instead of spreading out, it focusses to a small point.

### **Brownian motion.**

When observing scatter, it can be noticed that things in the water are jostling about often in a zig zag pattern. It occurs at an atomic and molecular level and is a natural phenomenon. Water is likely to contain anything, and with anything in the water, the liquid is trying to adjust its atomic and molecular structure, by breaking and making hydrogen bonding. This occurs on the average of  $10^{-15}$  and  $10^{-18}$  seconds timeframe.

### **Cross polarization influences.**

Linear cross polarising practices have the unique ability to differentiate between immersed solids in water that have refractive indexes at visible wavelengths and metals that do not. In particular with nanometre sized silver clusters, using two of such filters crossways is able to obscure the presence of any material that has a sufficient high level of a refractive index. Using photo-sensitive detectors, an estimate can be made between the amount of silver and that of other materials.

### **The Photo-electric effect**

The peculiarities of the photo-electric effect were described by Albert Einstein in 1909 and relates to a current flow between a cathode and an anode sealed in a glass bulb under vacuum. It was noticed that when the cathode was illuminated with light, a current would flow from cathode to anode at the level of that current read on a galvanometer. However it seemed impossible to explain why more light would not provide more current until shorter wavelengths of light in the violet and Ultraviolet were used. Now there appeared to be no limit as to how much current could flow.

### **Local Plasmon Resonances (LPRs)**

Local plasmon resonances are created when a photon collides with an electron in the so-called skin-depth of an atom. The collision causes a vibration and a local oscillation occurs of a brief duration. When the oscillation ceases and dies down, the interacting photon (a virtual polariton) leaves as a secondary emission. Normally there would be a loss of energy and thus a red-shift, but in the case of a collision between a photon and a quantum confined electron, the chance is high that there will be a blue-shift instead. Since blue-shifts possess a higher level of electron volt than a red-shift, more energy comes away from a lower energy source.

### **Quantum silver.**

The term quantum silver has been used to indicate the realm in which and how pico and nanometre sizes atomic clusters 10nm and smaller fall in the realm of Quantum Physics. For a start electrons are removed from the silver atoms and creating ionic material, totally dissolved in water and invisible. Photonic light at 420nm is used to return these now hydrated electrons back into the silver ions and make them neutral again but now immersed in the suspension of the water. Activity like this inside atoms are quantum events. There is also a departure from classical physics into quantum physics by **gravity and van der Waals forces** no longer having an effect. The borderline for this to occur is at around 10nm in size and smaller. Quantum Physics rules the **very small**.

### **CONCLUSION:**



**This Essay has been written to assist anyone involved in or with so-called colloidal silver to become more familiar with concepts and terminology of related matters. I trust this to be the case.**

**Author: Hans Laroo**