Title: COLLOID, METHOD OF OBTAINING COLLOID OR ITS DERIVATIVES AND APPLICATIONS THEREOF

Abstract: The present invention relates to methods of stable, metallic, nonionic, micro - and - nano colloid and sole making. In particular, the herein described colloids and soles are directly derived from the either pure metals or alloys. This invention relates also to numerous examples of colloids and soles, their applications, as well as numerous colloid and sole derivatives.
COLLOID, METHOD OF OBTAINING COLLOID OR ITS DERIVATIVES AND APPLICATIONS THEREOF

The present invention relates to the method of making the stable, nonionic, metallic, micro and nano colloids and soles, especially from pure metals and alloys, colloid and sole applications, and related product practical examples as well as colloid stabilizers.

Background of the Invention

The inventors shown in the US Patent 5885321 described the electrophoretic process of fine aluminium powder making. These inventors revealed also the other than aluminium powder making processes which involved copper and zinc as examples. Metallic fine powders in question here are made from the aqueous solutions, by an application of the electrophoretic principle, and by employment of the rotating cathode device.


Most of traditional methods of colloid making employs chemistry, and is therefore limited in the scope of their potential applications. An example illustrating such limitations relates to colloidal nano silver produced by precipitation from the aqueous silver nitrate solutions. Traditional methods of nano particle making shows typically low efficiency. In such traditional nano particle making there are some competitive phenomena resulting in metallic dendrites growth. In such cases the chemical precipitation must be aided by milling. The other disadvantage of the traditional nano particle making results from surface contamination. In such cases, the nano particle surfaces are contaminated by chemical reagents. These is difficult, if not impossible to remove such contamination by washing. In particular colloids used in pharmacy must maintain
very high level of purity. Impurities present on nano particle surfaces result in allergy of patients (an example – gold presently used in injections to joints).

In traditional chemical methods of colloid making only pure, single metal colloids can be made. Chemistry is incapable of making colloids of alloys. It is impossible for example to make by chemistry an uniform, stable colloid from the Au50%:Ag25%:Cu25% alloy. Only limited variety of colloids can be made by chemistry alone. Typically chemical colloid making methods employ water as the dispersing, or processing medium. Traditional chemical colloid making processes render unsuitable in case of metal dispersing in media such as: liquefied gases, silicone oils, hydrocarbon oils, alcohol, esters, glycols, liquid monomers, liquid polymers, etc. For example traditional chemistry is useless in mixing liquid A + D vitamin complex with the bio stimulating colloidal, nano silver.

Traditional processes of colloid making render also unsuitable in making numerous soles directly in gases. For example, it appears impossible to make by the traditional chemical methods an aerosol of nickel in LN2 (liquid nitrogen). While traditional methods of colloid making are well understood and practiced, the stability of nano and micro colloidal fluids, and the oxidation of the metallic particles in water adversely effect such colloid production. Inventors shown here found that colloids of copper, gold, palladium, platinum, nickel or chromium appear typically unstable in water. With exception of gold in aqueous colloidal suspensions, other fine metals tend to oxidize, or to hydrolyze in water quickly. Finally therefore in any type of aqueous colloids containing metal particles there are three types of nano or micro particles found: pure metals, metal oxides, metal hydroxides. This situation results in colloid agglomeration and the following sedimentation.

Summary of the Invention

The very subject of the following invention allowed these inventors to disperse the electrically conductive substances such as metals and alloys in water, aqueous mixtures, and other than water liquids. This task has been achieved by the principles of the described herein invention, focused in subjecting metals and alloys to an electrical critical current. Therefore, and under such critical current conditions, metals and alloys undergo dispersing in the surrounding liquids, or other than liquid media. Metals or alloys undergoing dispersion are termed here the dispersed materials. The medium in which the dispersion takes place is termed solvent or
dispersing medium. Colloidal systems comprise therefore two separate phases: the solid phase (the dispersed materials) and the dispersing medium (the solvent).

By this invention principles and methods, the useful and practical colloidal particle size most typically range from 5 to (50) to 100 angstroms. By the same principle, the electrical useful voltages needed for the colloid making method presented herein range from 1 kilovolt to 1 megavolt. By the same principle, the electrical current ranges from 500 amps to 250 kilo amps. The electrical current needed for the nano or micro particle fabricating process is termed here critical.

In accordance with the invention shown here, the dispersed materials are either: pure metals, pure metallic alloys, metals containing impurities, alloys between metals and non metals, metals manufactured by the powder metallurgy processes, combination alloys containing metals and dielectrics, or metals and semiconductors.

Also, and accordingly to this invention the dispersing media is understood as either fluids, vapours, gases or the combination of the above. Metallic nano particles generated by the rules and principles of this invention can be manufactured in the variety of gases, which during the fabrication process may be kept under broad range of pressures. By the virtue of this invention, the pressure of gases or vapours in which the nano soles are fabricated may vary from low to high. By similar principles and rules of this invention, a solid metal to colloid conversion can be performed under the variety of conditions: both in manual and automatic operation, single operation preferred in the laboratory, or continuous operation preferred in the industry. Also by the principles of this invention the nano or micro particle generating processes can be conducted in one by one arrangement, or in repeatable, or continuous mode.

It has to be pointed out, that originally and specifically this invention allows for converting metal to colloid to sole by explosive transformation which may take place in broad variety of final destination media such as:

- Silver in liquid vitamins or mineral supplements,
- gold "for injections" in water, or saline,
- chromium – nickel alloy in the silicone engine oil,
- palladium in benzene, toluene, in Diesel fuel or gasoline,
- gold and silver in oils, paraffin, olefins, waxes, etc.
This invention specifics and details pertain to the exceptionally small colloid particle dimensions: ranging most typically, but not exclusively from 5 to 50 angstroms. Also this invention allows for using the variety of process transformation media ranging from liquids to vapours, to gases and the mixture thereof. The colloidal particles generated by the rules and principles of this invention in structure render either crystalline or amorphous, or they form the combination of amorphous and crystalline structures. This invention, for the first time allowed also for a direct colloid making in monomers and/or polymers, thermosets, molding and extrusion compounds.

In stable colloids, the Brownian motions are responsible for preventing from agglomeration and sedimentation. The invention described herein uses, and aids such Brownian mechanisms in allowing for stable, metallic colloid making.

The peculiar and the unique properties of this invention rest also in selecting several unique stabilizing and reducing agents. Such colloid stabilizers comprise at list of one, but possibly few substances belonging to the following chemical groups:

- stabilizing metal deactivators
- reducing agents (acting on metal oxides or hydroxides)
- fluorosurfactants.

In the first group of substances mentioned above, and fundamental for this invention there are some chemical compounds such as: dimethylo benzyl difenyloamine, 2-mercaptan benzotriazol.

In the second group of substances mentioned above, and fundamental for this invention there are some chemical compounds such as: H₂O₂, KMnO₄, KClO₄, NaClO₄, HCl, HCOOH, CH₃COOH, benzoic acid, sulfuric acid, H₃CrO₄.

In the third group of substances mentioned above, and fundamental for this invention there are some chemical substances, and most likely the anionic or cationic or nonionic fluoro surfactants.

Each of the substances shown within these three groups presented above are fundamental for this invention. These substances may range in concentration from 0.01 PPM to 1% per weight. All colloids and soles made by the specifics of this invention are made by the Wire Electro Explosion.
This new and original aspect of the invention presented here relates to practical colloid and sole applications in which numerous nano and micro particle mixtures may be utilized in the broad variety of biological applications ranging from pharmacy or agriculture to sanitation to cosmetics. There are of course many other applications ranging from electronics, solar materials, energy conservation, air purification, fuels, lubrication, to polymer molding or extrusion, etc. By the principle of this invention, colloids used in pharmacy typically contain one or few precious (noble) metals, preferably silver, or gold or the silver–gold alloy, doped with at least one from the substances such as: palladium, platinum, copper, or platinum alloys, and precious with non-precious metal alloys. The useful pharmaceutical colloids are such, which by the principles of this invention allow for making the antibiotics, the disinfectants, the bacteria, fungi and spore killing agents, or human immune system stimulating and therapeutic agents. Such useful and beneficial agents used in illness prevention, therapy, sanitation, etc., maintain some form and the composition of water based colloids or soles typically containing also particles of silver and gold and their alloys.

The other field of potential application of materials made by the described here invention is in electronics. Here, substances made by the principles of this invention allow for making specific adhesives, printing inks suitable for use in electronics. Such include electrical contact lubricants. Colloids or their derivatives containing good known electricity conductors such as copper, gold, silver, or aluminium can be used as inks in circuit printing. The other important application of the materials generated by the virtue of this invention is in the areas of energy and auto fuels and lubricants. These are based in platinum group metals or alloys. There were numerous catalysts materials made by us. Such catalysts made as soles or colloids in hydrocarbons were shown to provide the unusual and unexpected benefits to the energy and transportation industries. We fabricated several colloidal and sole type catalyst media of platinum, palladium, rhodium, iridium, and their alloys. Tests conducted on combustible engines had shown that numerous soles and colloidal suspensions generated accordingly to the principles and teachings of this invention proved successful when applied to combustible engine fuels. The applications of catalyst made of platinum and other metals and alloys show great potential benefits to energy and automotive industries: Nano and micro colloids and soles made of
palladium, rhodium, ruthenium, platinum, iridium, osmium, and alloys had shown to benefit the automotive and energy industries four way:

1. By allowing in eliminating the need for the vehicle catalytic converters;
2. By improvement in the human environment conditions reduction in gases responsible for the world climate warning;
3. By decrease in emission of the unburned hydrocarbons, as well as other harmful substances typically present in the exhaust gases;
4. By substantial increase in combustion engine efficiency, and in reduction in gasoline consumption.

Though we did not run industrial factory tests, we did run an extensive testing in the laboratory. Based therefore in these tests results and observations we found that catalytic metals and alloys made in form of colloids and soles outlined in this invention show great potential benefits in combating earth warming phenomena. We also believe that the outlined here substances, made in accordance with and by the principles of this invention, may be used across the board in almost any industries ranging from chemical, to energy, to solar, electronics, to space exploration.

In the earlier mentioned field of pharmacy and medicine, the nano colloidal substances, generated by the principles of this invention, allowed for fabricating fluids and soles of great potential use in sanitation, disinfecting water, disinfecting hospital floors, disinfecting medical equipment, in disease prevention and therapy. Such fluids render exceptionally useful and effective in dermatology, ophthalmology, the branch of medicine dealing with ear, nose and throat diseases, urology, gynaecology, rheumatology, oncology, surgery, dentistry, general medicine and veterinary. In particular such medical application renders useful in combating paradentosis, and other mouth infections in humans. One may find the other powerful applications of colloids and soles made by principles of this invention. Such opportunities exist in the field of food plant disinfecting, disinfecting animal farms, disinfecting food processing machinery, and food products.

Nano and micro particles developed by the specifics and rules of this invention show several atomic structures: crystalline, amorphous, or mixed amorphous and crystalline. In case of fine dispersed alloys (in fluids and gases), such atomic structures appear jointly with variety of
atom positions as they form particle lattice. The nano particles lattice often differs from the lattice of the bulk materials from which the nano particles originate. We had found therefore the way to manipulate individual atoms in the nano crystalline structures. By crystal lattice manipulation the minute colloidal particles display therefore a number of useful characteristics. Number of colloids and soles made by this invention show to destroy bacteria, viruses, fungi or protozoa. Such unique and surprising properties result from suitable atom positioning in Nan particles. The useful particle size for all the above listed applications range from 5 to 100 angstroms.

**Detailed Description of the Preferred Embodiment**

Presented here novel invention and discoveries thereof, vividly demonstrate numerous practical methods and applications of the nano and micro non ionic metallic substances. Such substances may comprise metal(s), alloy(s) and the mixtures of metals with dielectrics and semiconductors. This novel, revealed herein process of colloid and sole making is conducted typically in two following steps: first based in metal disintegration, second in mixing. Colloid or sole carrier (the solvent) may appear in several forms such as: vapours, gases, liquids, and even cryogenic liquids. Particles present in micro and nano colloids range in sizes from 5 angstroms to .2 micron. Nano and micro colloid particle surface areas range from 10 to 1000 square meters per gram of substances dispersed. The micro particles described here most typically range in size from 0.005 microns to 0.2 micron. The respectable surface area range from few to about 25 square meters. Surface area of the metallic phase of colloids and soles depends not only on the particle size, but also on particle size distribution, metal density, metal crystalline structure, and particle geometry. It appears therefore not possible to deliver a suitable mathematical formula which relates colloid surface area with the other physical and chemical properties.

As we said earlier, there are two separate processes involved in colloid or sole making by this invention: metal disintegration and metal mixing with the suspending media. Both processes occur simultaneously. At first metal or the alloy is placed in the dispersing medium such as: vapour, gas, liquid etc. Secondly, and by using the outer electrical energy source, the powerful electrical current pulse is passing through the solid metal sample which is placed inside the dispersing medium. An electrical current pulse which is responsible for metal disintegration must be of precisely chosen in amplitude (current density), and duration. Under such an electrical current pulse metallic, solid sample breaks to fragments. The emerging multitude of metallic
pieces form suspension. This suspension comprises solid micro or nano material mixed with liquids, gases, or vapours.

While the disintegrated metal fragments form a myriad of objects (the suspended phase), the surrounding media forms as a "solvent", or "carrier". Typically, disintegration process described here lasts from a fraction to few microseconds. Such a very short time of an electrical pulse duration is paramount to the success of the process outlined herein.

The inventors conducted theoretical studies focused on pinpointing the cause of metal disintegration phenomenon. Such studies were paramount to the success of the invention presented here. We produced a scientific explanation as to the causes of metal explosion by current. MJ Pike-Biegusinski described the quantum mechanical origin of the electrotensometric forces responsible for the described metal scattering. (Appendix I). The inventors had therefore discovered the limitations and restraints paramount to this novel technology. Such limitations are governed by the "process physics". By the rules of created and useful theory, the longitudinal forces termed electrotensometric are responsible for metal disintegration. These forces must overcome the natural forces of metal cohesion. By teaching of physics, the tensile strength of metals is related to their specific structure and specific temperature. Most typically, but not exclusively, it is easier to disintegrate hot than cold metal. Base in our theory teaching, it is easier to disperse aluminium, or copper than tungsten, or molybdenum. On this same token it is easier to disperse hot than cold chromium. However, experiments conducted in presented here studies have shown that at sufficiently high current densities any metal may be broken in pieces. It however fundamental for the success of this invention to carefully experiment in order to find the most suitable process conditions. Such process conditions are specific for the selected metals or alloys. Metal breaking conditions depend also on the chosen medium. Prior to any practical colloid development process, it is required therefore, to long practice through laboratory experimenting.

In summary each metallic crystal is characterized by two important technological factors: actual tensile strength (to be determined for a certain temperature), and needed current pulse characteristics. While metal tensile data is commonly available, an electrical pulse characteristics must be determined in the laboratory. Such an electrical pulse characteristics (needed for developing efficient processes) must include circuit design and characteristics. Circuit characteristics comprise knowledge on circuit size, inductance, resistance, capacitance, pulse
voltage, pulse current, and current/time relationship. Once such characteristics and as well as other process parameters are known, the colloid fabrication process may be tried for the broad variety of dispersing media.

The very subject of this invention is focused on the micro and nano particle making processes and applications. Processes described herein can be conducted in variety of media including, but not limited to, liquids, gases and vapours. In particular such processes, by the principles of this discovery, may be carried out in vapours kept at critical conditions of: pressure, temperature and volume. Such processes must be designed in view of critical electrical currents requirements for metals. Such currents acting on metal via the longitudinal electrotensometric forces result in suitable metal dispersion.

We termed new class of micro and nano substances “the vapour soles”. Such form of metallic fragments is made exclusively by metal breaking in vapours. Vapour soles are somewhat similar to aero soles. The vapour soles differ from the aero soles by the constituency of the dispersing medium. While aero soles are made in gases, the vapour soles are made in vapours. The more common processes of aero sole making mentioned here occurs by exploding wires in gases. Such gases used in the aero sole making may be kept under low or high pressures. In similar fashion, and by using the discovery shown here, nano and micro colloidal substances may be made in variety of liquids such as: cryogenic liquid gases, organic or silicone liquids, water and aqueous mixtures, liquid monomers and polymers. These may be kept at various, and suitable temperatures.

This invention, and the applications hereafter allowed these inventors, to dramatically expend on variety and composition of colloidal and sole substances. This is so, since this invention for the first time allowed to transform to colloid or sole any metal or alloy. By the principle of this invention therefore, the entire family of metals and alloys can be transformed to great variety of future novel and useful materials. This is why this invention allows for making a myriad of new substances, never before available to science and technology.

While the traditional chemical processes of metal fragmentation, and the consequent colloid making are relatively long, cumbersome, often risky, the process outlined here is quick, and relatively easy. Accidental time of single metal dispersion is measured in microseconds or
less. In the developed, and described here process there is no waste or need for complicated chemical after processing.

The process of explosive micro or nano particle making is clean since it does not live waste behind. However, nano or micro particles generated under the conditions outlined herein are produced in rather broad spectrum of sizes. Centrifugal sedimentation, or filtering may be used therefore for narrowing the span in particle sizes. The described herein metallic micro and nano particles are of two atomic structures: amorphous and crystalline. The crystalline structure originates from the wire disintegration caused by the longitudinal, electrostensometric forces alone. These most typically are shapeless. The amorphous structure is generated from the molten and quickly quenched metal fragments (in media). Such molten fragments originate from arcing and plasma. These most typically are of spherical shape.

The extra fine particle making process described here may be conducted in the variety of media including single fluids or their mixtures such as water and alcohol, oils and an organic solvents, liquid gases, etc. The nano particle making processes may be carried out in gases at various temperature and pressure conditions. This invention allows (for the first time) in developing the final and useful forms of the colloidal substances through a single operation based in metal explosion. Also in numerous instances colloids can be made in medium of final destination at once. One may therefore manufacture gold for injections directly in saline. Conversely, the traditional colloid making processes require a series of chemical steps which typically include rinses and complicated transfer of substances. Such transfers and rinses are characteristic of all existing chemical colloid making processes. On the contrary, all processes of colloid making by an electrical wire explosion do not require chemistry, rinses, and material transfer.

Consider as an example the nano silver colloid made by silver breaking in liquid vitamin A + D. In similar fashion the chromium – nickel alloy can be dispersed directly in toluene, benzene or car fuel, etc. Suitable metals, oxides and sulfides may be dispersed in lubricants. Processes of colloid making shown here may be carried out in liquids, or cryogenic gases. In case of metallic soles or vapours, these may be manufactured originally in gases and than dissolved in liquids. This process allows for the unique structure of final colloidal forms. Drying copper from the liquid nitrogen colloid allows to generate copper powder which is virtually free of oxides.
Typically the described by these inventors processes of fine metal powder making of are environment friendly. They do not produce waste, or by products. Such processes may be designed as either automatic or manual. The automatic processes are of importance from the industrial manufacturing point of view. A single industrial colloid generator may be used therefore for making a great variety of diversified nano or micro products. This is why the inventors consider this invention revolutionary.

The inventions and new technology presented here allowed for the novel, and useful materials development. The inventors believe, that such micro and nano materials create a new avenue in future nano technology material development and applications. Such applications range from sanitation to pharmacy, to cosmetics, electronics, energy, automotive, clothing, solar, and space technologies. In technology of electronic materials alone this invention offers novel printing inks allowing for fabricating the variety of elements such as: resistors, inductors, capacitors, filters, sensors and transducers. By using materials produced by the principles this invention, it became feasible to print magnets, electromagnetic filters, and other novel microelectronic circuit elements. Some other nano colloidal materials generated under this invention conditions may serve in developing new generation of an electrically conductive adhesives used in the surface mount technology. Conversely such highly electrical conductive adhesives can not be formulated by the existing metal powder technology based in milling.

Many nano powders generated by using this new technology allowed also for creating new class of high purity metallic standards. Such standards are needed for the spectroscopy and for science at large. In this case metal disintegration would take place in liquid nitrogen, or helium. Metal phase upon evaporation leaves behind the extra pure nano metallic powders. This principle is of high importance to several fields of spectroscopy such as: precious metal standards, non precious standards, alloy standards e.g. SS 316 ( ASTM – USA ), silicon and germanium, or powder metallurgy standards, etc.

Prompted by the principles and the subject of this invention, we may expand on the potential use of the dispersing media: dry air, wet air, air at temperatures ranging from 291 to 299 Kelvin and normal pressure, and also at pressures ranging from 0.01 mm Hg to high pressures. The following example demonstrates a particular and unique application of this invention: Gold, silver and copper were exploded electrically in dry nitrogen gas, which was kept at 3 atmosphere
pressure set inside the reactor. The respective aero soles of gold, silver, and copper respectively were generated in this gas. Metal soles produced under pressurized here nitrogen were then introduced to water by a capillary glass tube. Finally water colloids were made. This experiment was repeated with success in other than water liquics such as: alcohol, oil, liquid polymer. By using this process sequence an electrical arc and plasma do not contact, nor interacts with the dispersing media.

From the industrial point of view, metal and alloy processing by pulsing current is far more diversified from any known chemical colloid making process outlined here. However simple, the explosive methods of colloid and sole making also requires hands on experience. Such hands on experience ought to lead to selecting the most suitable manufacturing conditions.

Some metallic colloids received our particular attention. For that reason the inventors focused their attention on metals and alloys destined for processing in water. Focused on this task alone, the inventors generated several water stable colloids of copper, aluminium, silver, gold, platinum, rhodium, iridium, palladium, molybdenum, tungsten, titanium, hafnium, tantalum. We also worked with numerous other alloys and elements.

As example, the inventors fabricated numerous water colloids by using metallic alloys such as: Pt Rh, PtIr, PdNiCrCuAg . On occasion several water colloids previously fabricated were also made in mixtures of water and alcohols, water with esters, ethers, aldehydes, acids.

The particular attention of inventors was focused on water colloid making from the dental alloy. We succeeded also in this task. These inventors believe that the best technological conditions can be found by using rules and descriptions shown here.

Therefore the inventors feel this patent application body and description meets all educational rules and requirements set by the patent law. Furthermore the inventors trust that by using teachings and examples presented herein, any skilled engineering personnel will be capable of reaching satisfactory technical results and achievements in all revealed here substances and teachings.

Examples:

In order to demonstrate the principles, and applications of this invention thereof, eight independent examples, each related to pertinent nano material fabrication and processing have been shown below:
Pharmacological Nano Colloid of Silver

Electronic Colloid of Copper

Energy Colloid of Palladium

Sanitation Silver Colloid Used in Disinfecting Water

Selection of substances used in stabilizing metallic and alloy colloid

Stabilized Sanitizing 75 PPM Nano Colloid of Silver

Stable Nano Colloid of Copper for Use as an Anti Fungi Agent

Stabilized Colloid Made of Ag-Cu-Au Alloy for Applications in Dermatology

Example I: Pharmacological Nano Colloid of Silver

Nano colloid termed "Pharmacological" was made by using the 0.1 mm in diameter, and 50 mm in length silver wire. This wire was attached to two solid tungsten electrodes immersed in the DI water at 15 degrees Celsius. The suitable SS reactor had the volume of 0.250 cubic decimeter. The electrical current pulse was detected by using the Tektronix 2230 memory oscilloscope equipped with the 100 meg. sample memory. The positive polarity electrical pulse of 0.7 micro second was detected as it was followed by the negative polarity pulse of 0.9 micro second duration. Total pulse duration was therefore calculated as 1.6 micro second. The average pulse current was measured at 1200 Amps. The measurements accuracy was 5%. Current density was calculated at 15.3 meg amps. We fired the said silver wire in sequence of four events in series. Silver concentration was measured by using turbidity. Colloidal silver concentration was determined by weighting after each single firing. The results are: 16 mg/liter after first firing, 32mg/liter after two consecutive firings, 48 mg/liter three consecutive firings, and 64 mg/liter after four consecutive firings. We used turbidity measurements in order to relate fluid optical density to the amount of dispersed silver. Such turbidity measurements were in linear correlation with the number of firings (r = 0.995). There was progressive darkening of the colloidal solution, as optical density was increased after each firing. In general colloidal fluid color ranged from straw (after one firing) to milky brown (after four consecutive firings).

This colloid was tested for bacterium coli suppression (for data see text)

Example II: Colloid of Copper for Application in Electronics

In this example LN2 (liquid nitrogen), at minus 196 Celsius was used as copper colloid disperse medium. The rector chamber made of stainless steel was thermally insulated. This
chamber was equipped with two massive tungsten electrodes and was filled to half volume with liquid nitrogen. Copper wire dimensions were identical with the silver wire shown in example I. The mass of copper was 3.4 gram per firing. The electrical voltage was 10 kV. Using five consecutive firings the amount of 17 mg of pure copper was suspended in LN2. After gas evaporated, the resulting copper powder was mixed with the Epon® 862 epoxy resin made by Shell Chemical Company of Houston, Texas, USA.

There were two comparative electrical screen printed paths: one in which we used the commercial epoxy based conductive copper ink, the other made by the application of this novel copper ink. The electrical conductivity of this new, and covered by this invention ink path had shown the 5 times higher electrical conductivity than the competitive, market product.

Example III: “Energy Colloid“ of Palladium

This experiment was focused devoted toward fabricating the nano palladium colloid in which metal was dispersed in the standard unleaded motor fuel. We tried to prove the increase in energy output by using motor fuel enriched with nano palladium catalyst. Thin palladium foil of 0.076 mm by 3.175 mm was cut to the length of 2.54 cm. This sample mass was calculated at 74 mg. This sample dispersion was conducted at 15 kV in motor fuel. The obtained colloid of palladium was mixed with standard fuel and used in testing on standard, one cylinder, 8HP engine. This combustion engine was used to power the electrical, single phase generator. Engine/fuel efficiency was measured by using the electrical power measurement. The electrical power generator was connected to the standard electrical resistor for measurements. Energy efficiency was found to increase by 15 % as compared with the standard catalyst less fuel.

Example IV Sanitation Silver Colloid Used in Disinfecting Water

In the following example the colloidal nano silver was used in water in order to demonstrate the unusual disinfecting properties. This liquid media was fabricated by the principles and teachings shown in example I. The aqueous silver colloidal concentrate was fabricated at 64 mg/liter (62 PPM) metallic silver concentration. This was an nonionic colloid. In testing silver concentrate was diluted with the bacteria polluted ground water. Such water was of extreme high concentration of bacterium coli. There were 6 practical silver concentration levels tested: These ranged from 0.15 PPM - low to 1.2 PPM-high. We did not use higher silver concentration than 1.2 PPM in water..
The following table shows test results. The initial bacterium E. coli count (NPL) was adjusted at the following five concentration levels: 1.600.000, 160.000, 13.000, 8.000 and 5.000 (NPL) in 100 ml of water tested. There was the four hour period in which the bacterium coli was treat with silver. Sanitation effects were observed and demonstrated as following E. coli (NPL) count upon colloidal silver application (after 4 hours of exposure at room temperature):

- the original, initial bacteria level of NPL 1.600.000 was reduced to 160.000 with 0.9 ppm of silver, and to 90.000 with 1.2 PPM of silver;
- the original, initial bacteria level of NPL 160.000 was reduced to 40 with 0.9 PPM of silver and 20 with 1.2 PPM of silver;
- the original, initial bacteria level of NPL 13.000 was reduced to less than 20 with both 0.9 and 1.2 PPM of silver;
- the original, initial bacteria level of NPL 8.000 was reduced to less than 2 at 0.45 PPM and 0.6 PPM of silver;
- the original, initial bacteria level of NPL 5.000 was reduced to less than 20 at 0.15 PPM and 0.3 PPM of silver.

These data shows vividly the unusual power of disinfection with nano silver. For high level of bacteria 1.0 PPM of silver proves effective. For lower bacteria level 0.5 PPM of silver seems optimal.

In the same laboratory testing we found colloidal silver not to adversely effect water quality. The pH factor, the hardness, turbidity, color, and typical level of cat ions nor the anions concentration shoved changes in water sanitized with nano silver. In the same studies we found no allergy and toxicity effects in experimental animals upon the addition of up to 2PPM of silver to drinking water.

In numerous experiments metallic nano colloids of silver and gold were found to destroy large number of gram positive and gram negative bacteria. Aqueous Silver was found therefore to be a potent bacteria killing substance effective in combating the following bacteria groups:

Bacteria Killed Effectively by Nano Silver Colloid (10 PPM concentration) at Room Temperature was: *Escherichia coli*, *Shigella sonnei*, *Shigella flexneri*, *Salmonella typhi*, *Salmonella derby*, *Salmonella bovis morbillicans*, *Vibrio cholera*, *paradontosis complex*, *Helicobacter pylori*, *Bacillus anthracoid*, *Candida tropicalis*, *Staphylococcus aureus*, *Diphtheria*. 

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We found in also in testing of over 500 medical cases, that fabricated by us the Anti Paradontosis Complex kill all bacteria and fungi in paradontosis of humans. We used in this case colloid of the copper – silver alloy, 50 PPM in water. In our testing we also found that colloids made of metallic alloys poses number of the antibiotic properties unknown to standard medicine and pharmacy today. In our studies numerous viruses, bacteria, fungi and algae were found to be eradicated by using certain nano colloids comprising the alloyed elements such as; silver, gold, copper, palladium, chromium, and other. This important scientific discovery allowed the investors to name this new group of medications “the crystalline antibiotics”. As an example, and by the principles of this discovery we found that copper-zinc alloy enriched with sulfides form in water a potent anti fungi colloid suitable in numerous applications found in agriculture and husbandry. In particular such colloidal substances were found to combat numerous diseases of potato and tomato. Some other metallic alloy colloids made in the isopropyl alcohol were found to be a suitable mean in arts - artifacts conservation. This were tested on old oil paintings, old furniture, mummies, leather products etc.

Results obtained in fields of agriculture proved exceptionally useful in the field testing on brown leaves diseases of potato and tomato.

Example V: Selection of substances used in stabilizing metallic and alloy colloids.

At first these inventors analyzed numerous colloid stabilizing substances revealed in literature. It was found however, that the recommended elsewhere colloid stabilizers do not work in our technology. We could not therefore stabilize metallic and alloy nano colloids by the knowledge deduced from the existing chemical experience. Finding proper metallic nano colloid stabilizing media became therefore and integral part of this invention. As we pointed out earlier, the nano colloids made by the wire explosion method tend to oxidize, agglomerate, and finally sediment. In this task we examine numerous available and recommended colloid stabilizing substances including: polyethyl and methyl glycol, vinyl alcohols, tannin, proteins, triazoles including benzotriazole. These were used in stabilizing heavy metal colloids. We also tested stabilizing properties of the following recommended substances:

Gum Arabica - from Aldrich USA
Natrosol (Hydroxyethyl) - from Hercules, USA
Cellulose Gum (Carboxy Methylcellulose) – from Hercules, USA
Polyvinyl Alcohol – from Aldrich, USA
PVP K-90-ISP (Polyvinyl Pyrrolidinone) – from GAF, USA
Gum Xanthan from Aldrich, USA
Polyox WSR 303 from Union Carbide, USA
Methocel 240-S (surface treated) from Dow Chemical, USA
Methocel 228-S (surface treated) from Dow Chemical, USA
Methocel K4M from Dow Chemical, USA

Unfortunately by using the above listed substances, all test conducted in order to stabilize metallic nano colloids rendered negative results.

In the other experiments the inventors tested the impact of the pH factor on colloid stability. We found that most of the metallic nano colloids render unstable at pH ranging from 4 to 11, and at metal concentration level above 1.0 PPM. Testing therefore had shown the further need for search for colloid stability. During colloid stability testing these inventors had found that numerous colloids made of aluminium, copper, silver, palladium and alloys tend to oxidize. Such nano particle surface oxidation was found to make colloids unstable. This observation prompted the inventors to look for means to prevent colloid particles surface oxidation. We found also that certain fluorosurfactants help in gaining colloid stability. In summary we were able to identify few groups of substances suitable for colloid stability: antioxidants and fluorosurfactants. It was found later that the third stabilizing group of substances is needed, in particular when applied to colloids of higher metal concentration. In this third group, these inventors identified the following substances; Octamin (octyl - difenylamine), and Naugex (2-merkaptopbenzotriazole).

In conclusion, and surprisingly these inventors had found that colloids made by wire explosion requires for stability three peculiar and unique groups of stabilizing compounds: fluorosurfactants, oxide reducers, and surface deactivator which possesses additional anti oxidizing properties.

Example VI: Stabilized Sanitizing 75 PPM Nano Colloid of Silver

Inventors undersigned here manufactured the 75 PPM silver nano colloid which was earlier described in the Patent Application P 365435. The said colloid was fabricated in the DI water. Observations of the colloid in question had shown long time instability stability. In order to stabilize the said silver colloid the addition of 0.01% if hydrogen peroxide was made. To the said
colloid the inventors also added a 1PPM of the FC431 fluorousurfactant commercially available from 3M Company in US. Finally the inventors added to the said colloid of silver the amount of in 0.1% per weight of octamine solution in alcohol. Such complex treatment allowed the inventors to generate quite stable final product displaying a 90% long time stability determined after one year of open air warehouse storage. This procedure therefore ended with full technological success our nano silver colloid manufacturing process.

Example VII: Nano Colloid of Copper for Use as Anti Fungal Agent

These inventors produced a 100 PPM nano colloid of copper, as it was described in the earlier Patent Application P 365435. This colloid was fabricated in the DI water. Copper colloid rendered as made unstable. In order to stabilize the said colloid the following substances were used as additives:

Hydrogen Peroxide 0.025% used as the oxide reducing agent.
Surfactant FC741 at 5 PPM concentration in water as surface active agent.
Naugard XL-1 in alcohol at 5ppm as metal deactivator.
Upon said treatment, copper colloid rendered stable over one year warehousing.

Example VIII: Stabilized Colloid Made of Ag-Cu-Ag for Applications in Dermatology

These inventors produced a 50 PPM aqueous nano alloy colloid of Au10%Ag70%Cu20%. This colloid was made under the conditions earlier outlined in the Patent Application P 365335. This colloid was made by the wire explosion method, and it was forseen as medication for use in dermatology. The above colloid testing had shown benefits in numerous infectious skin diseases treatments. Unfortunately the above colloid rendered unstable. We stabilized the said colloid by using additives specific for this invention:

--Oxide reducing agent KMnO4 at 20 PPM concentration in water
--Zonyl FSC from Du Pont – USA, at 10 PPM concentration in water
--We did not use the antioxidants in this case.
Upon such treatment the said medical colloid had shown good stability.

Several useful examples shown here were given for the educational purposes. These examples demonstrate also multiple practical purposes of using colloid stabilizers in industrial practice. The examples shown above do not limit or do not exhaust all other applications developed according to the invention.
References:

Maciej J. Pike - Bieguske A.T. Research and Development, Milford, Michigan, USA. "The Nonthermal Interactions Between Electrons And Metal Crystalline Lattice". Zeszyty Naukowe Politechniki Łódzkiej, Elektryka z.95 2001( nr.868 ) pages:17 – 40 (tekst in English)
Claims:

1. A method of producing colloids, or colloid derivatives characterised in that an electrically conductive solid body is placed in the dispersive media, then through this solid body an electrical critical current pulse is passing, and this solid body is dispersed to micro or nano particles.

2. A method according to claim 1, wherein the micro particles sizes range between 0.2 and 0.01 microns, and the nano particles sizes range respectively between 5 to 1000 angstroms.

3. A method according to claim 1, wherein electrical pulses voltage ranges in amplitude between 1kV and 1 MV, especially between 1kV and 50 kV.

4. A method according to claim 1, wherein electrical current pulses ranges in critical value from 500 amps to 250 kilo amps.

5. A method according to claim 1, wherein the electrically conductive solid body is selected from the group consisting of: suitable pure metals, metals contaminated by impurities, alloys or alloys formed by the principles of powder metallurgy, mixtures of metals and insulators, or metals alloyed with semiconductors.

6. A method according to claim 1, wherein the dispersion media is selected from the group consisting of: vacuum, gases, vapours, liquids, including the cryogenic liquid gases, or the combination thereof.

7. A method according to any claim 1 to 6, wherein, the obtained colloid is introduced into a secondary medium selected from the group consisting of: liquids, liquid mixtures, liquid monomers, or liquid polymers.

8. A method according to claim 7, wherein prior to introduction to the secondary medium at least part of the dispersion medium is removed.

9. A method according to any claim 1 to 6, wherein manual or automatic processing devices or operation is used.

10. A method according to claims 1 to 9 consisting of continuous or repeatable sequence of manufacturing steps.

11. A method according to claims 1 wherein the nano and micro particle generation is conducted in the final media and the obtained colloid is selected from the group consisting of:
silver sole in compressed gases, silver colloid in water, gold in water or saline, metals in liquid vitamins or mineral supplements, liquid nano medications, palladium in fuel, molybdenum in oils, or chromium – nickel in silicone oils.

12. Colloid characterised in that it comprises:
   a) electrically conductive dispersed substance consisting of crystalline, amorphous, or the mixed solid nano-particles in size ranging between 5 to 1000 angstrom,
   b) dispersion medium selected of gases or liquids or composition thereof.

13. Colloid according to claim 12, characterised in that it is further dispersed in gas, vapour, liquid or mixture thereof or in polymer.

14. Colloid according to claim 12, wherein the dispersed substance is selected from the group consisting of: pure metals, pure alloys, contaminated or purposely doped metals and alloys, mixtures and alloys between metals and semiconductors, or metals and dielectrics.

15. Colloid according to claim 14, wherein the dispersed metal is selected from the group consisting of: precious metals, precious metal alloys, and precious metals alloyed with the non precious substances.

16. Colloid according to claim 12, characterised in that it is selected from the group consisting of: silver in vitamins and in mineral supplements, gold in water or saline, chromium – nickel in silicon oils, palladium and other catalytic metals and/or alloys in combustible hydrocarbons.

17. Colloid according to claim 12, characterised in that it comprises further stabilizing compounds selected from the group consisting of: oxide or hydroxide reducing agents, surfactants acting as the surface active agents, and metal deactivators acting as the additional colloid stabilizing agents.

18. Colloid according to claim 17 wherein the oxide or hydroxide reducing agent is selected from the group consisting of: \( \text{H}_2\text{O}_2, \text{KMnO}_4, \text{KClO}_4, \text{NaClO}_4, \text{HCl}, \text{HCOOH}, \text{CH}_3\text{COOH}, \text{Benzoic acid} \), \( \text{H}_2\text{SO}_4, \text{H}_2\text{CrO}_4 \).

19. Colloid according to claim 17 wherein the surfactant is selected from the group consisting of: ionic or nonionic fluorosurfactant.
20. Colloid according to claim 17 wherein the antioxidant is selected from the group consisting of octylated diphenyloamine, dimethylbenzylidiphenyloamine, 2-mercaptobenzotriazole.

21. Colloid according to claim 17 characterised in that the stabilizing compound is contained at concentration level ranging from 0.01 PPM to 1%.

22. Colloid according to claim 12 characterised in that it is produced by the wire electrical explosion according to claim 1 to 11.

23. An applications of colloid according to claim any of claims 12 to 22 in obtaining medication, herbicide or pesticide.

24. An application according to claim 23 wherein in obtaining the medication is used colloid containing metal or alloys, in particular selected from the group consisting of: precious metal such as silver, gold, the alloys of gold, silver, palladium, platinum, rhodium, iridium, copper, vanadium and other common metals.

25. Application according to claim 23 in obtaining antibacterial composition selected from the group consisting of: antibiotic, disinfectant or decontaminant.

26. Application according to claim 23 characterised in that obtained composition have form of hydrosol of silver or silver alloys.

27. An application of colloid according to claim any of claims 12 to 22 in obtaining electronic materials, and mainly adhesives, inks for printing electronic circuits, printing of passive circuit elements, and fabrication of electronic grade greases and lubricating oils.

28. Application according to claim 27, wherein used colloid comprises the electrical conducting metals, preferably selected from the group consisting of: copper, copper alloys, silver and silver alloys, gold and gold alloys, palladium and palladium alloys, aluminium and aluminium alloys.

29. An application of colloid according to claim any of claims 12 to 22 in obtaining fuel additives, general lubricants and automotive lubricants.

30. Application according to claim 29, wherein used colloid comprises at least one platinum group metal or alloy thereof.

31. An application of colloid according to claim any of claims 12 to 22 in obtaining composition for disinfecting, illness prevention, therapy, or other medical treatments in:
dermatology, ophthalmology, internal medicine, urology, gynecology, rheumatology, oncology, surgery, dentistry, veterinary, treatment in paradentitis, treatment in arthritis, food technology, food preservation, food storage, in disinfecting food industry equipment, agriculture, husbandry, pesticides and herbicides.

32. Nano or micro particle composed of at least of two electrically conductive metals characterized by two different and specific properties, such as anti bacterial and anti viral in combination, or anti bacterial and anti fungal in combination.

33. Nano particle according to claim 32 possessing dimensions ranging from 5 to 100 angstroms.

34. Micro particles according to claim 32 ranging in dimensions under 0.2 micron.

35. An application of colloid according to claim any of claims 12 to 22 in obtaining energy and fuel additives, particularly selected from the group consisting of combustion engine fuel catalyst, combustion engine energy booster, combustion engine exhaust purifier, combustion engine after burning agent.

36. Application according to claim 35, wherein used colloid comprises at least one platinum group metal or alloy thereof.

37. Method of fabricating spectroscopic standards by braking electrically pure metals, and alloys in liquid nitrogen or helium, and by receiving dry metallic material upon gas evaporating.