

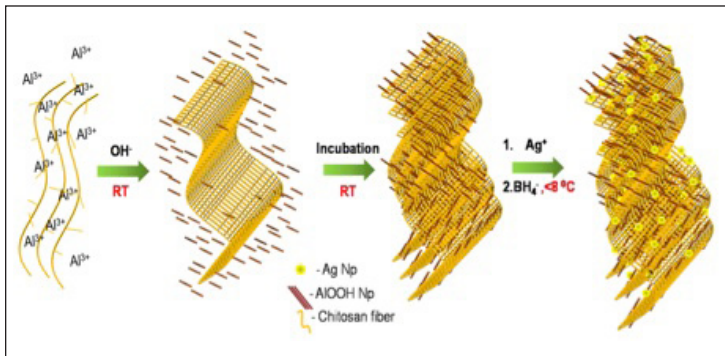
Silver News

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Silver Nanotechnology Paves the Way for Cleaner Water Supplies

New Technology Enables Lower Cost, Longer Lifespan Product

By Dr. Trevor Keel, Technical Consultant to The Silver Institute



Forming silver nanoparticles into nano-size cages helps limit scale formation in water filters.

CHITOSAN

One in ten of the world's population lack access to safe water, according to the United Nation's World Health Organization (WHO). Contaminated water and poor sanitation are linked to the transmission of a range of diseases and conditions including dysentery, cholera and diarrhea. These are all easily treatable and preventable, but they continue to lead to millions of deaths every single year primarily in low-income countries. For example, the WHO estimate that more than 800,000 people die each year from diarrhea as a direct result of unsafe drinking water, poor sanitation and inadequate hand hygiene.

It has long been known that silver ions can be used to purify water, and silver-based filtration systems that limit the proliferation of dangerous microorganisms have been used in various forms for well over 50 years. Many silver-containing water filters are available for purchase today by individual consumers.

The uptake of such technologies in low-income countries has been tempered by their relatively high cost. However, the work of one Indian professor has begun to change this situation. Professor Thalappil Pradeep and his team at the Indian Institute of Technology in Madras have been working on the use of silver nanotechnologies for water purification for more than a decade and, in 2013 published [a paper in the Proceedings of the National Academy of Sciences](#) describing the development of improved materials for the consistent release of silver ions in water as a means to provide safe drinking water for all. These materials maintain a constant silver ion concentration of 50 parts per billion in water, enough to kill germs while remaining safe for humans.

The key breakthrough of Professor Pradeep's 2013 work is that silver ion release from most materials decrease with time as scale-forming species deposit on active surfaces. Here, the silver nanoparticles are synthesized in nanoscale cages formed by aluminum oxyhydroxide nanoparticles (AlOOH Np). In this

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system water can move freely into the cage and generate silver ions, but scale-forming precursors cannot. This limits scale formation, permitting silver ion release for longer periods at controlled concentrations. Additionally, the materials used to form the cages are cheap and simply made from water-soluble ingredients, further strengthening their applicability to water clean-up in low-income countries around the world. The team has now implemented these new materials in the development of an improved water purifier to deliver clean drinking water at a cost of US \$2.5/year per family. Importantly, the filters themselves do not require electricity for their operation.

Over the last decade, Professor Pradeep's work has accelerated and many milestones have been achieved. In 2007 his group developed a [water filtration system](#) which was capable of eliminating endosulfan, malathion and chlorpyrifos - three pesticides that were found at elevated levels in Indian water supplies. This led to over 1.5 million silver nanofiltration units being sold in India, and he estimates that these have improved the quality of water supply of more than 7.5 million people. More recent work has seen his new silver-based technologies combined with other novel nanoscale cages to help remove arsenic from water, a breakthrough which has now reached 400,000 people in India. This has now been approved for national implementation by the ministry of drinking water and sanitation.



THALAPPIL PRADEEP

A drinking water purification unit using nanosilver was installed at a school in an arsenic-affected region in India, delivering arsenic-free water to 300 students. Hundreds of similar installations have been carried out, with other models serving larger communities.

Exceptionally Strong 2015 U.S. Silver Jewelry Sales

Seventh Consecutive Year of Growth

Silver jewelry sales in the United States were solid in 2015 with 60% of jewelry retailers reporting increased sales, according to a survey conducted on behalf of the Silver Institute's [Silver Promotion Service \(SPS\)](#). This marked the seventh consecutive year of growth for silver jewelry sales and confirmed that silver jewelry is an increasingly important category for many retailers.

Highlights from the 2015 survey include:

- The average growth in 2015 for silver jewelry sales was 15%;
- Retailers said their silver jewelry sales, as a percentage of their overall jewelry sales, were on average 35% of their unit volume and 27% of their dollar volume;
- 45% of retailers said silver experienced the best turnover rate in 2015, followed by diamond jewelry at 22%, bridal at 17%, gold at 12% and platinum at 4%;

Silver Powder Gives Luxury Watch Dials Their High-End Finish

For generations, luxury watchmakers relied on a treatment known as 'graining' to produce an aesthetically pleasing finish and also to protect the base metal dial from rusting. Traditionally, the graining treatment was difficult and expensive to undertake and only the most exclusive brands were capable of producing such a finish. Graining was first attributed to the widely-known 18th century French watchmaker Abraham-Louis Breguet, who used mercury to achieve a frosted effect. Other watchmakers have since used aggressive acids. Both methods are unacceptable in modern watchmaking because of the materials' toxicity to workers.

Today's luxury watchmakers want the same graining finish without the dangerous materials. Now, three new models by Swiss watchmaker Urban Jürgensen exhibited at *Baselworld 2016*, the global watch and jewelry show, sport a grained dial that gives the much-desired frosted effect. To achieve this look, Urban Jürgensen begins with a disc of fine silver engraved with numbers and markings. Layers are then added step-by-step as a proprietary mix of silver, salts and other ingredients are hand-brushed onto the dial. Through an electrochemical process, the surface becomes pearly, giving a silvery, frosty surface with depth and granularity. Because the treatment is done by hand, no two watches are the same, which the company says adds to their individuality.



URBAN JÜRGENSEN

Silver powder helps to give this Urban Jürgensen Reference 1741 Platinum watch dial its frosted effect.

- 87% of retailers say they are optimistic that the current silver surge will continue; and
- The age group buying the most silver jewelry is 20-40, according to nearly 60% of the retailers.

SPS Director Michael Barlerin commented, “The Silver Institute/Silver Promotion Service was obviously gratified by what the survey demonstrated. Silver’s outstanding performance was the result of multiple interrelated factors, including the fact that 57% of retailers reported they had increased their inventory on average of 21%.”

The survey was conducted by National Jeweler/Jewelers of America and was fielded in February/March of this year. This was the seventh consecutive year that SPS has conducted such a survey.

A copy of the report can be downloaded here: [2015 Silver Jewelry Survey Results](#)

Image of Silver Particle from 141-Year-Old Photos Enlarged a Million Times, Turned Into Sculpture

Contemporary British artist Simon Starling explores the journey of objects as they transform themselves through time, material and geography. In his 1997 work *Blue Boat Black*, for example, he took a wooden Victorian museum display case, used it to make a fishing boat, and then burnt it to produce charcoal to cook the fish he caught from the vessel.

From now through June 26, the Nottingham Contemporary museum is showing the largest exhibition in the U.K. of Starling’s works, including one that investigates the hidden properties of silver halide photography. For *Nanjing Particles*, the artist took two silver particles from Victorian-era photographs and enlarged their image a million times. From that likeness he formed a sculpture of the particles.

In a 2015 [interview](#) in conjunction with the Imagine Reality art exhibit produced by several German museums, Starling discussed how he produced his silver sculpture: “I extracted some silver particles from the prints’ emulsion and viewed them under an electronic microscope. Each of the particles that constitute the image has three-dimensional, sculptural characteristics. We identified two particles and made images of these particles from many different perspectives, so we were able to build a three-dimensional model of them using software developed at Albany University. These models were then sent to an art foundry in Nanjing, China, who blew them up to one million times their original size and then forged them in stainless steel.”



URBAN JÜRGENSEN

Click image to watch the Nottingham Contemporary’s exhibit of works by Simon Starling

Smart Contact Lenses Rely on ‘Invisible’ Silver Wires

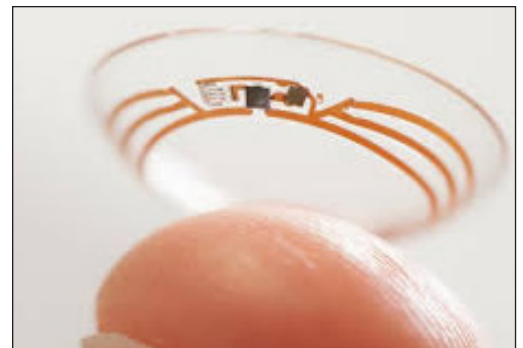
May Lead to Wearables That Measure Glucose in Diabetics

Chinese scientists have developed an ‘invisible’ electrical circuit inside a polymer used in producing contact lenses. The circuit is invisible to the naked eye because it was formed by silver wires measuring just one micrometer wide -- narrower than the diameter of a typical bacterial cell. The scientists produced the wires by injecting droplets of silver ink into the polymer known as dimethylsiloxane, which is used in contact lenses for its optical clarity and safety.

One challenge to smart contact lens makers has been producing circuits small enough so they don’t distract the wearer or block their vision. Professor Song Yanlin and his team at the Institute of Chemistry at the Chinese Academy of Sciences in Beijing have helped to overcome these drawbacks by injecting silver ink into the lens polymer and producing a conductive mesh of tiny wires that measure only one micrometer in width. They said that the circuits remained operational even after the polymer had been bent many times.

Aside from contact lenses, the silver-circuited polymer could be used in other wearable devices such as artificial skin that can measure temperature and perspiration and prosthetic limbs that can measure pressure placed on them.

The scientists’ research paper titled *Fabrication of Transparent Multilayer Circuits by Inkjet Printing* was published in a recent issue of [Advanced Materials](#).



GOOGLE

Google is another company working to advance smart contact lens technology. This video shows a smart lens that measures glucose in a patient’s tears.

'Miniature' 3D Printer Aimed at Unique Silver and Gold Jewelry Market

Beijing-based company [Yibo3D](#) has recently unveiled a miniature 3D metal printer designed to produce gold and silver jewelry. Because of its precision abilities, it may also find applications in aerospace, research tools and medical equipment, company officials said.

The printer is a step forward in 3D printers because it offers precision grade production but is the size of a small washing machine. Comparable printers might be the size of a large metal cabinet. The cost is lower, about US\$150,000, compared to millions of dollars for current printers with the same abilities.

The YBRP-140 SLM miniature metal 3D printer was first shown in public at the China-Germany industrial park in Qingdao, Shandong Province, earlier this year.

Like larger 3D printers, the YBRP-140 printer uses Selective Laser Melting (SLM) technology, which uses laser beams to melt metal particles into exact shapes.

At the debut, company officials said the printer is aimed at the low-volume jewelry market. They noted: "Taking the example of iron materials, the machine can print in layer heights of just 0.02mm. Furthermore, if we make a 100 mm part, accuracy will deviate as little as 0.1 mm."

The Chinese government is backing 3D technology and an [International Data Corporation \(IDC\) report](#) bears this out: About 34,000 units were shipped within China in 2014, and that number has already more than doubled to over 77,000 units in 2015, says IDC. The global consultancy predicts that 160,000 3D printers will be sold in China during 2016.



This miniature 3D printer was designed to produce gold and silver jewelry.

YIBO3D

Silver Iodide Cloud Seeding in Los Angeles During Recent Storm Brings 15 Percent More Rain

During a March, 2016, El Niño storm in Los Angeles government officials seeded the clouds with silver iodide, producing an estimated 15% more rainfall.

It was the first time since 2002 that the Los Angeles Department of Public Works had seeded clouds, a practice that dates back to the 1950s.

El Niño is a cyclic warming of the ocean surface or above average sea surface temperatures in the Pacific Ocean. They can disrupt normal weather patterns leading to intense storms in some places and droughts in others.

The Los Angeles region has been in a multi-year drought which last year prompted a half-million dollar (US) yearly contract to Utah-based North American Weather Consultants. When the El Niño was forecasted, an opportunity for cloud seeding by the company arose. They set up land-based seeding generators in 10 locations, several of which were activated as the storm clouds moved around.

Cloud seeding generators shoot silver iodide in the clouds, which produces ice crystals. Water vapor freezes on the particles, which produces rain.

Officials say that silver iodide doesn't produce rain clouds but coaxes more rain from existing ones.



In ground-based cloud seeding generators, a propane flame is used to vaporize the seeding solution, which is composed of silver iodide mixed in acetone. The vaporized silver iodide then re-crystallizes in the cold air, forming millions of tiny particles which are intended to serve as ice nuclei. The generators are positioned to maximize the number of silver iodide crystals that reach the critical regions of passing storms.

Worldwide Nanosilver Market to Hit US\$2.4 Billion by 2023

The global nanosilver market was valued at US\$700.9 million in 2014 and is anticipated to reach US\$2.4 billion by 2023, expanding at a compound annual growth rate of 14.8% between 2015 and 2023, according to a recently published report.

Nanosilver Market – Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2015 - 2023, from [Transparency Market Research](#) states: "In terms of revenue, electrical & electronics accounted for a major share of the nanosilver market in 2014, and this trend is projected to continue during the forecast period." Healthcare is expected to be the fastest growing end-user segment of the nanosilver market in terms of revenue during the forecast period. "It held nearly one-third share of the global nanosilver market in terms of revenue in 2014," the report noted.

The report also details the many uses for nanosilver, including: food packaging, textile manufacturing, filtration, purification and neutralization processes in the water treatment industry, personal care products, detergents and optics. "Novel applications of nanosilver in the field of biomedical are expected to create new opportunities for market players," the report stated.

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Groundwater Clean-Up Aided by Silver Chloride

A contractor at the U.S. Department of Energy's Savannah River Site (SRS) is cutting groundwater clean-up costs by almost US\$11 million annually by injecting silver chloride into the aquifer.

The silver chloride mixes with iodine-129 – a by-product of nuclear reactions – forming harmless silver iodide. Previously, contractor Savannah River Nuclear Solutions (SNRS) used more expensive mitigation techniques involving highly-mechanized pumps and treatment facilities.

“Finely milled silver chloride particles, reduced to about 1/4 micron in size, are injected with water into the aquifer, and are extremely effective at capturing the iodine-129,” said SNRS Geologist Gerald Blount in a prepared statement. “Working with Savannah River National Laboratory scientists, we’ve found that over a short time period the silver chloride can permanently bind the hazardous iodine-129 as silver iodide, because of its strong natural chemical affinity.”

From the 1950s through the late 1980s, the Savannah River Site produced nuclear materials used for national defense. As a result, a portion of the groundwater beneath the site's “F Area” became more acidic. Small amounts of radioactive tritium, uranium, strontium-90 and iodine-129 were found as well.

Recent test results indicate that the silver chloride has significantly decreased “the hazard posed by iodine-129” in the F Area aquifer. At the same time, the remedial costs associated with groundwater contaminants have been reduced, resulting in a cost avoidance of approximately 90 percent. The price tag has gone from about \$1 million a month to \$1 million a year.



SRNS operators monitor the injection of silver chloride into the aquifer beneath the Savannah River Site. Results of a recent test indicate a significant decrease in the hazard posed by contaminants where silver chloride was injected.

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