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Silver News

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Triple Silver-Coated Building Glass Saves Energy, Looks Beautiful

By Trevor Keel, Technical Consultant to the Silver Institute

LucasFilm's Sandcrawler building in Singapore uses Solarban 72 glass containing a triple-layer of silver.

Solarban 72 glass is fitted in the re-designed Fulton Center in New York City to aid environmental control and building aesthetics.

Silvered mirrors have long been a popular domestic application for the metal, with evidence suggesting that communities in China fashioned simple mirrors using silver-mercury amalgams to coat metallic objects over fifteen centuries ago. During the nineteenth century, an effective method of coating silver onto glass was discovered in Germany which led to broader availability of affordable mirrors.

There is a modern-day version of this technology all around us, yet few people are familiar with it. Hundreds of millions of square feet of silver-coated glass are used in buildings worldwide each year. There are two key reasons for this. From an environmental perspective the transparent coating of silver gives the windows the ability to both reflect hot summer sun and retain internal heat. This permits easier climate control within larger buildings, thus minimizing energy usage. Also, from an esthetic perspective, silver provides an attractive hue popular with architects and building inhabitants alike.

In 2011, *Silver News* reported on the introduction of a new type of glass developed by PPG Industries. The technology, Solarban 72, contained a triple-silver coating, giving it excellent solar control capabilities alongside improved visible light transmittance. Since its release, Solarban 72 glass has been used in numerous award-winning buildings worldwide, including LucasFilm's Sandcrawler facility in Singapore and the Fulton Center in New York City.

Various iterations of Solarban glass products have been used in iconic buildings for over 50 years, and silver has played a key role in its popularity from the 1980s onwards, particularly with regard to energy efficiency. According to company officials, a single coating of silver was incorporated into the product formulation in 1983, followed by a double coating in 1989, and then the first ever triple coating in 2005.

Before PPG Industries sold its flat glass business to Mexican glass maker Vitro in 2016 they released another Solarban product – Solarban 90. Again, silver was at this heart of this

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new glass with the incorporation of a layer of nanoparticles in addition to a triple coating of silver. According to PPG, the nanoparticle layer allows product developers to further manipulate the glass's reflectivity, color and solar performance. The formulation was developed with input from architects to fulfil their requests for a clear, neutrally-reflective architectural glass that delivers enhanced solar control. Combined with clear glass in a standard 1-inch insulating glass unit (IGU), it has a solar heat gain coefficient of 0.23 (solar radiation admitted through a window, both directly transmitted and absorbed and subsequently released inward), visible light transmittance of 51 percent (percentage of visible light transmitted through the window) and a light-to-solar-gain ratio of 2.22 (the efficiency of different glass types in transmitting daylight while blocking heat gains). Interior and exterior reflectance rates are 12 percent and 19 percent, respectively. These measures are all balanced against one another to provide appropriate performance and esthetics, and they are considerable improvements over previous Solarban products.

This technology has won a number of awards, including a 2016 R&D 100 award from R&D magazine which recognized the ongoing development of solar control, low-e glasses (glass that emits low levels of thermal energy) such as Solarban 90, as being critical to the advancement of sustainable design because they transmit high levels of daylight while blocking most of the sun's heat energy. These characteristics reduce reliance on artificial lighting and air-conditioning, which together consume nearly 70 percent of the energy used by commercial buildings in the U.S. Studies also show that buildings with high levels of daylight produce better environments for health, productivity, learning, healing and psychological well-being. In February 2017, Solarban 90 won a Readers' Choice Award from *USGlass* magazine in the category of primary glass products, with the technology recognized for being the industry's first quad-silver-coated glass, combining a true neutral-reflective appearance with outstanding solar control.

The importance of energy efficient climate control in modern buildings, combined with esthetic appeal, will ensure the continuing demand for silver-containing glass in the coming years.

Silver Coating Allows Super Thin Medical Probe for Spinal Tests

Medical probes help doctors and researchers better understand what's going on inside the human body, but some areas are so sensitive or fragile that inserting a brittle probe can damage the patient.

For example, nerves in the spinal cord are particularly delicate and a probe that accidentally touches another nerve, one not being stimulated for investigation, can cause serious damage and even paralysis. Because the spine bends and shifts as the body moves, scientists have been seeking a probe that is flexible and thin – roughly as thin as a human hair – that also serves as an excellent conductor of electricity.

Silver helps to meet these requirements.

Massachusetts Institute of Technology researchers together with scientists at the University of Washington and Oxford University have developed a rubber-like fiber that can bend and twist while delivering electrical stimulation and optical signals – like from a laser - without injuring nearby nerves. The fiber they produced can act as a waveguide for optical signals, and a mesh of silver nanowires surrounding it offers a conductive coating for the electrical signals. Silver is the world's best metal conductor and extremely flexible.

Finding the right material was not easy, said Professor Polina Anikeeva in a statement. "The spinal cord undergoes stretches of about 12 percent during normal movement. You don't even need to get into a 'downward dog' [yoga position] to have such changes. The goal was to mimic the stretchiness and softness and flexibility of the spinal cord."

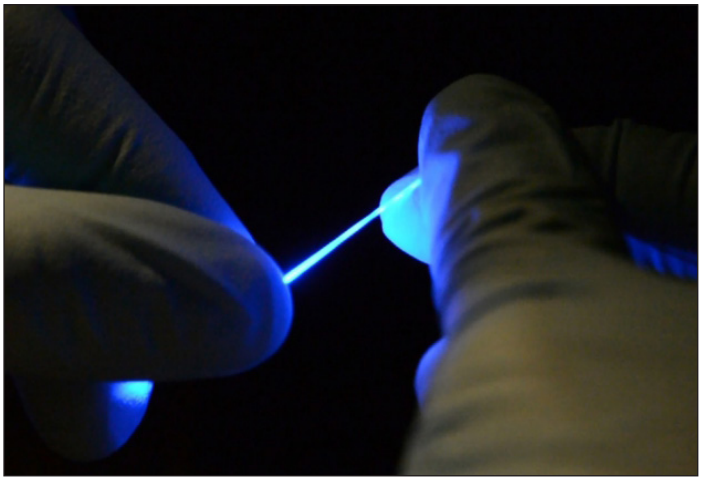
She said the material is so flexible and thin that it could even be used for sutures.

She described the fiber as "really just a piece of rubber, but conductive." It can stretch by at least 20 to 30 percent without affecting its properties.

The new fiber opens up research opportunities. Scientists prefer to perform research on mice because they are inexpensive, breed quickly and allow easy manipulation of genetic traits. Their drawback is that their nerves are very small and can be injured using currently available probes. To counter this issue, scientists studying spinal cords use larger animals which are more expensive and breed more slowly. Now, the newly developed thinner fiber with silver coating allows experiments on mice.

The research was supported by the U.S. National Science Foundation, the U.S. National Institute of Neurological Disorders and Stroke, the U.S. Army Research Laboratory, and the U.S. Army Research Office through the Institute for Soldier Nanotechnologies at MIT.

A paper describing the research titled *Flexible And Stretchable Nanowire-Coated Fibers For Optoelectronic Probing Of Spinal Cord Circuits* is available here.



CHI (ALICE) LU AND SEONGJUN PARK]

Researchers have developed a rubber-like fiber, shown here, that can flex and stretch while simultaneously delivering both optical impulses, for optoelectronic stimulation, and electrical connections, for stimulation and monitoring.

Scientists Take Their Inspiration From Nature When Producing Silver Nanostructures

Engineers are always working to produce structures with the least weight, the highest strength and that take up the least space. This is especially true in the manufacture of artificial bones and other structures used in medical applications.

3D printing offers the opportunity to produce many intricate shapes using silver nanoparticles for their microbe resistance but the question remains: what's the best shape?

Scientists at the Washington State University are taking their cues from natural structures, especially those found in the desert, because nature almost always produces the most efficient shapes with high strength-to-weight ratios like the naturally occurring crystals known as the African Desert Rose.

The Desert Rose is a natural crystal formation that occurs when fog containing sulfur evaporates in the African desert causing grains of sand to stick together. Scientists have replaced sand with silver nanoparticles and reproduced the structure of the desert rose using a 3D printer.

They accomplish this by dispersing silver particles in a water-based solution known as aqueous ethylene glycol, which creates an ink that is atomized into a fog by the 3D printer jet. The resulting structure is then sintered using a heat source.

Rahul Panat, associate professor at Washington State University, notes: "This is a groundbreaking advance in the 3D architecturing of materials at nano to macroscales with applications in batteries, lightweight ultrastrong materials, catalytic converters, supercapacitors and biological scaffolds. This technique can fill a lot of critical gaps for the realization of these technologies."

Silver was used because it is easy to work with, but the method can be expanded to other nanoparticles, Panat said. The group produced other intricate structures including microscaffolds that contain solid truss members like a bridge, spirals, electronic connections that resemble accordion bellows and doughnut-shaped pillars.

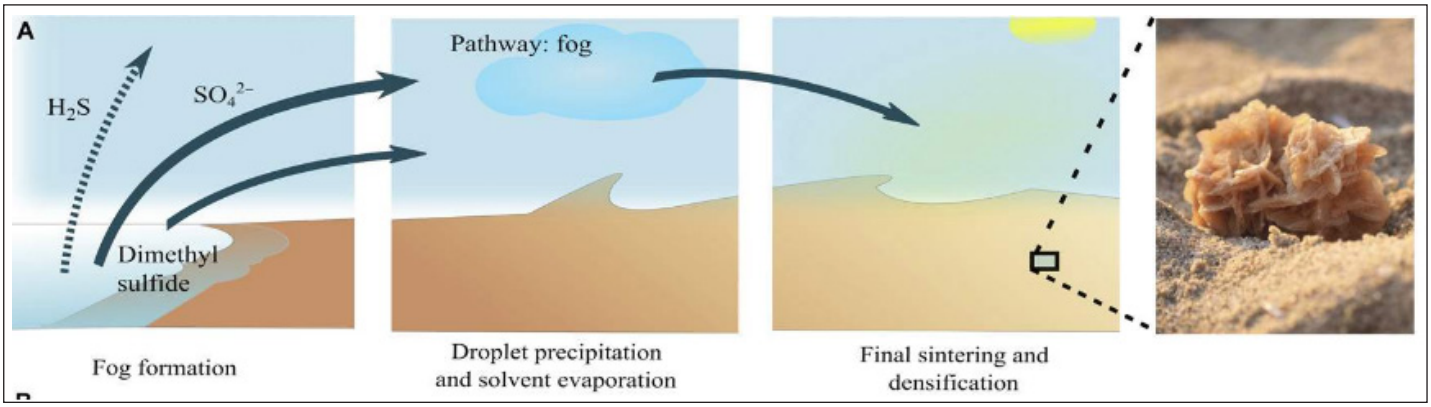


IMAGE VIA SCIENCE ADVANCES.

The formation of a Desert Rose.

Silver Gum May Go With Space Travelers to Mars

The United Arab Emirates plans to build the first city on Mars by March 2117, and if a Dubai-based professor has her way, the interplanetary travelers will chew silver-imbedded gum on their trip.

Franziska Apprich, PhD, an assistant professor at Canadian University Dubai, in partnership with a colleague at New York University Abu Dhabi, is creating what she calls "UAE Space Gum."

The gum contains natural gum, silver particles, date paste, honey and vitamin C. "Chewing gum can help relieve tension, which may be an issue for those taking a voyage into the unknown," Apprich told the *Khaleej Times* in Dubai. "It can also help maintain oral hygiene, which is a practical concern for space travelers. The gum is all natural, so that no harmful additives are absorbed into the system. The vitamin C provides support to the immune system in what will be an unknown environment, and the silver is used to treat bacteria in the mouth to prevent gum disease. Honey delivers an energy boost, while the date paste provides flavor, and of course, a tribute to the culture of the UAE."

At the recently-held Gulfood Innovation Hub conference in Dubai, Apprich met with UAE suppliers for her gum ingredients and is hoping to present her idea to the UAE Space Agency and other government agencies to gauge their interest in the gum.

Strong Institutional Investment Pushes Silver Prices Higher

The price of silver is up about 11% this year (as of April 25) largely due to improving sentiment among institutional investors, according to the Silver Institute.

"Changing expectations towards the outlook for U.S. interest rates and the proliferation of negative policy rates across other key reserve currencies has rekindled institutional investor interest in precious metals," according to a press release. "Meanwhile, a marked improvement in silver industrial offtake, led by photovoltaics, which achieved a record high last year, is also helping. All these factors in turn have fueled investment inflows into silver futures, options, exchange traded products (ETPs) and over-the-counter products."

To read the entire press release, click here.

Silver Investment Demand

Million Ounces

	2011	2012	2013	2014	2015	2016E
Physical Investment	271.0	239.3	297.4	284.4	309.0	215.9
ETPs	-26.1	52.1	14.8	0.1	-15.9	45.9

Source: Metals Focus

Sturdy U.S. Silver Jewelry Sales Continued in 2016

Silver jewelry sales in the United States were strong in 2016, with 62% of jewelry retailers reporting increased sales, according to a survey conducted on behalf of the Silver Institute's Silver Promotion Service (SPS). The results showed that 2016 was the eighth consecutive year of silver jewelry sales growth.

In addition, 89% of retailers say they are optimistic that silver jewelry sales will continue to grow and 49% of retailers said that silver jewelry gave them the best maintained margins during the holiday season, the highest percentage compared to other categories including gold, platinum and diamonds.

Highlights from the survey include:

- The average store growth in 2016 for silver jewelry sales was 16%. Eight percent of retailers reported an increase in sales of over 25%.
- 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.
- 54% of retailers said silver experienced the best turnover rate in 2016, followed by bridal and diamond both at 17%, gold at 10% and platinum at 2%.

You can download the report here.

Cotton Incorporated and PurThread Team Up on Silver Imbedded Fabrics

Cotton Incorporated and PurThread Technologies, Inc. have announced a collaboration to imbed odor-controlling silver into cotton knit and woven fabrics.

PurThread's U.S. Environmental Protection Agency-registered recycled silver salts are inserted into fiber and filament yarn during the extrusion process. This lends permanent fabric protection from odor-causing bacteria, mold, mildew and fungus. The antimicrobial benefits do not wash away or wear off for the life of the fabric nor does it change the fabric's physical characteristics, officials of both groups say.

"Consumers know and love cotton, and they have come to expect performance technologies like odor control in their athletic apparel. The continued growth of the athleisure category creates an ideal opportunity to expand established athletic apparel performance technologies to additional categories, such as denim," said Mark Messura, Cotton Incorporated Senior Vice President, Global Supply Chain Marketing. "The fabrics created through this collaboration maintain the look and feel of cotton and add long-lasting anti-odor properties. The PurThread technology is effective and does not impact fabric design. We look forward to sharing these developments with the industry, because we believe they are the right innovation at the right time."

Lisa Grimes, CEO of PurThread Technologies noted: "Blending PurThread with cotton to offer permanent antimicrobial protection offers tangible benefits. Apparel can be worn for longer periods of time between washings, helping to reduce water consumption and energy usage."

Antibacterial and Biodegradable Packaging Uses Silver

If someone could produce a biodegradable food container that was also antibacterial, two problems could be solved at once – environmental responsibility and food safety.

"Food packaging is mainly made from various plastics, which are being produced from non-renewable sources and are non-biodegradable. Also, it is not always possible to recycle them because leftover food [in the containers] amounts to almost 50 percent of packaging waste," said Paulius Pavelas Danilovas, PhD. researcher at Kaunas (Lithuania) University of Technology (KTU) Department of Polymer Chemistry and Technology.

Danilovas and his research team may have come up with a unique solution by producing food bags made of biodegradable cellulose – found in plants cells – which is imbedded with silver particles.

The silver particles will keep food fresher longer, he said, adding that discarded packaging containing leftover food could be used as fertilizer.

This is not the first time that silver has been imbedded into non-biodegradable plastic or paper food packaging for commercial sale or imbedded into paper made from cellulose used in other applications. However, this is the first time that cellulose bags with silver have been used to store leftover food at home.

Aside from the environmental and food safety benefits, the cellulose packages became even stronger and more elastic when the silver particles were added, said Danilovas. Yet, he predicts they will biodegrade in about two years.

Prototypes are being tested by a commercial enterprise.

KTU

KTU researchers Vesta Navikaitė-Snipaitien and Paulius Pavelas Danilovas.

Silver Nanowire Inks Offer Advantages Over Other Nanoshapes for Electric Components

In an attempt to make smaller and smaller printed circuit boards that hold thousands of micro-components for use in mobile phones and other electronic gadgets, manufacturers have been applying silver nanoparticle inks to plastic surfaces. However, this method becomes unsuitable with extremely thin surfaces because the inks are hot and can melt the plastic.

Now scientists at Duke University have formulated an ink composed of silver nanoparticles that does not require heat.

They found that electricity flows more easily through silver nanowire shapes than through nanospheres or microflakes. Electrons flowed so easily, in fact, that no heat was needed to melt them together into a smooth liquid capable of being shot through extremely tiny nozzles.

"The nanowires had a 4,000 times higher conductivity than the more commonly used silver nanoparticles that you would find in printed antennas for Radio-frequency identification (RFID) tags," said Benjamin Wiley, Ph.D., assistant professor of chemistry at Duke, in a prepared statement. "So if you use nanowires, then you don't have to heat the printed circuits up to such high temperature and you can use cheaper [and thinner] plastics or paper." He added: "There is really nothing else I can think of besides these silver nanowires that you can just print that's simply conductive without any post-processing."

Wiley's group tried different nanoparticle shapes before deciding on nanowires and were not surprised that it ended up having the highest electric conductivity compared to other structures. In any liquid with suspended silver nanoparticles, electrons have to 'jump' from nanoparticle to nanoparticle to complete a circuit. Because they are relatively longer, nanowires required fewer jumps between particles thus offering less resistance. They were, however, taken aback by the amount of decrease in resistance. "The resistivity of the long silver nanowire films is several orders of magnitude lower than silver nanoparticles and only 10 times greater than pure silver," said Ian Stewart, a graduate student working with Wiley.

Future work includes experimenting with different aerosol jets to find the best match for the silver nanowires as well as using silver-coated copper nanowires which are cheaper to produce than pure silver nanowires.

U.S. Mint to Issue Military Service Branches Medals to Accompany 2018 Silver Coins Honoring WW I Veterans

The U.S. Mint will issue silver medals to complement silver coins available next year that will commemorate the service of World War I veterans. The medals will honor the five branches of the U.S. military.

Over 60 design candidates have been submitted for consideration and are under review and discussion by the Commission of Fine Arts and by the Citizens Coinage Advisory Committee.

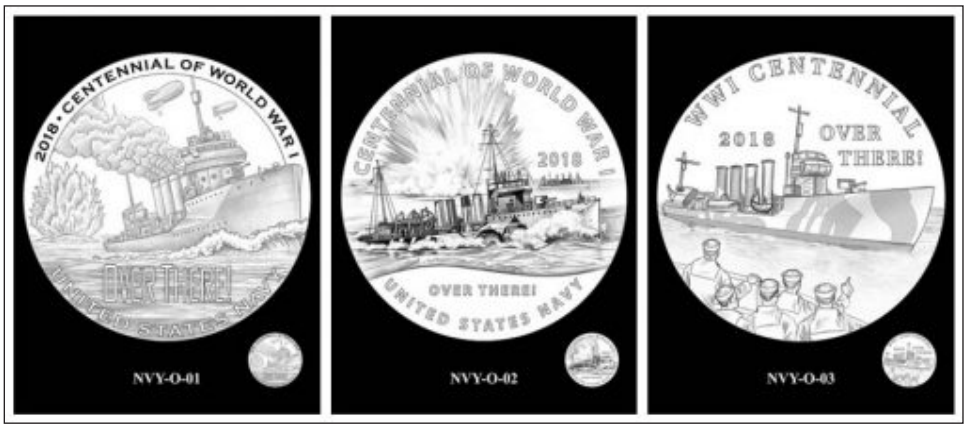
Final decisions on the designs and price will be made later this year. There is also a possibility for a sixth medal honoring women who served in the war, as requested by the U.S. Citizens Coinage Advisory Committee. Women did not serve in combat roles during World War I but served in other positions both on and off the field of battle.

To see the various services' medals design candidates click on the following links from Coin News.

Army (see Army medal designs), Air Service (see Air Service medal designs), Marines (see Marines medal designs), Navy (see Navy medal designs) and Coast Guard (see Coast Guard medal designs).

The coins that the medals will accompany are the result of then President Obama signing the *World War I American Veterans Centennial Commemorative Coin Act* into law in 2014, which filled a void in commemorative coins. Although other wars have been honored by coins, World War I veterans have never been commemorated in this way. The U.S. entered World War I in 1917 although the conflict had been going on in Europe since 1914. It ended with an armistice on November 11, 1918, and the U.S. celebrates Veteran's Day each year on that date. About four million men and women from the United States served in uniform during World War I.

The coins will be composed of 90% silver, 10% copper and weigh 26.73 grams. The design for the silver coins has not yet been made public nor has the price been set. The U.S. Mint hinted at the price, however, on its website by noting that "The 2015 prices for silver dollar commemorative coins were US$51.95 for proof quality and US$48.95 for uncirculated quality."



COIN NEWS

These designs have been recommended for WW1 medals honoring U.S. Navy veterans.

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