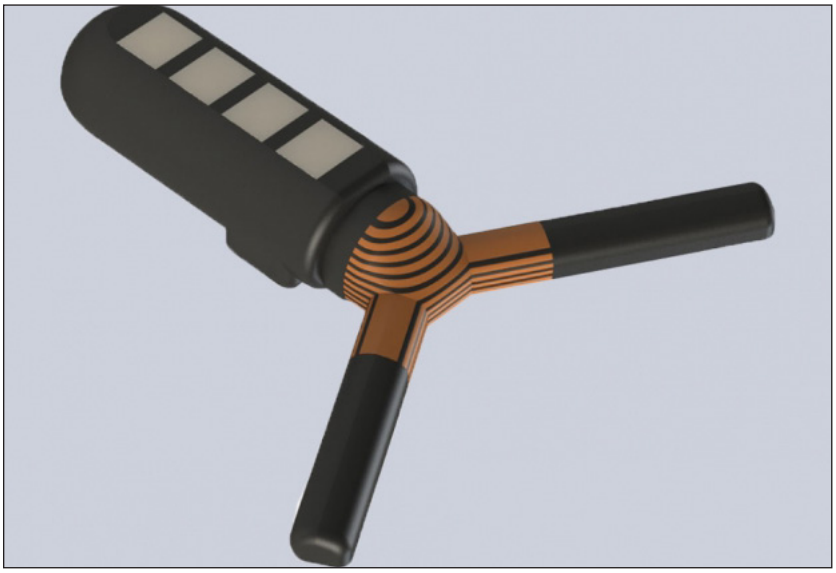
THE SILVERINSTITUTE

December 2018

Silver News

Ingestible Capsule Powered by Silver-Oxide Battery

One of Many New Devices Using Silver-Oxide/ Zinc Button Batteries



MIT

This ingestible capsule, powered by a silver-oxide battery, can communicate information to, and take orders from, a smartphone.

"Our system could provide closed-loop monitoring and treatment, whereby a signal can help guide the delivery of a drug or tuning the dose of a drug." -- Giovanni Traverso, MIT visiting scientist.

A capsule designed to be swallowed and remain in the stomach for several months before breaking apart and passing through the digestive system is being powered by a tiny silver-oxide battery because of the cell's long life and consistent power.

The capsules, which are manufactured using 3D-printing technology, could be deployed to deliver drugs, especially those that must be taken over a long period. The capsules could also be used to sense infections, allergic reactions, gastric juices, fever or other conditions, and then release a drug in response, according to Massachusetts Institute of Technology (MIT) scientists.

"Our system could provide closed-loop monitoring and treatment, whereby a signal can help guide the delivery of a drug or tuning the dose of a drug," said Giovanni Traverso, a visiting scientist in MIT's Department of Mechanical Engineering, in a prepared statement.

The capsule looks like a conventional drug capsule but can eject and open small arms upon command. Each arm has four compartments that can be filled with different drugs and released through a smartphone signal connected by Bluetooth wireless technology.

Researchers say that the sensor feature could detect early signs of a disease and automatically respond with medication. They say that possible uses could include monitoring people at high-risk for infection and deploying an antibiotic, or releasing antihistamines when a patient shows an allergic reaction.

Yong Lin Kong, Assistant Professor at the University of Utah and the research paper's lead author, said:

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"We can potentially create customized ingestible electronics where the gastric residence period can be tailored based on a specific medical application, which could lead to a personalized diagnostic and treatment that is widely accessible."

The research team, which included scientists from MIT, Draper Laboratory, and Brigham and Women's Hospital, was funded by the Bill and Melinda Gates Foundation and the U.S. National Institutes of Health.

This capsule is one of many new applications for silver-oxide batteries, and the market is forecast to grow in the coming years as consumers are becoming aware of the product's quality and how it is used in an increasing number of devices, especially wearables. Currently, the global silver-oxide battery market is valued at US$15.5 billion and is expected to surpass US$19.70 billion by 2025, according to a report issued in July by Coherent Market Insights.

Ross Dueber, President and Chief Executive Officer of battery maker Zpower, says the growing market for wearable technologies, especially hearing aids and earbuds, is going to create considerable demand for silver-zinc batteries. Dueber's comments were included in a background paper on silver's role in batteries published by the Silver Institute in October. One of the company's most recent collaborations was with Bose, who have just released wireless noise-masking earbuds which are powered by ZPower's silver-zinc batteries. "Our success with hearing aids and Bose is just the beginning," Dueber said. "We are capitalizing on this momentum to establish silver-zinc batteries as a preferred power source for the growing number of electronic devices that require smaller, safer and more energy-dense solutions."

Black Silver Holds Promise of More Efficient Solar Cells and Powerful Sensors

A new material dubbed "Black Silver" by its inventors has the ability to improve solar cells because it strongly absorbs light. It can also be altered to sense minute traces of biomolecules, which would make it ideal for biosensors that detect dangerous or toxic chemicals.

The crucial element of this material's abilities is its nanosilver structure, which can interact with tiny amounts of visible and infrared light, providing solar cells with more electricity-producing power. The material consists of silver particles, which are 1,000 times smaller than the width of a human hair.

Moreover, producing the nanomaterial does not require acids or high heat; it can be made at room temperature. This also allows the material to be coated onto many substrates without fear of melting them.

"The material can be deposited at room temperature on a range of substrates without patterning or acids," said Singapore University of Design and Technology Assistant Professor Robert Simpson in a prepared statement. "So far we have deposited the material over 100 mm diameter plastic silicon and silica samples. This single-step large area fabrication method makes the material industrially relevant. Indeed, the nanostructures were grown using a modified technique that is commonly used to manufacture tinted films on large area window glass."

The research, published in Nano Energy, was done in collaboration with Dalian University of Science and Technology in China.

Silver and Seaweed Attack Biofilms

An ongoing challenge for food and beverage makers as well as healthcare workers using catheters and ventilators on patients is the build-up of biofilms from bacteria. Making some equipment and medical parts out of silver, or silver-coating them, can help. Now, researchers at the Indian Institute of Technology, Roorkee (IIT-Roorkee, India), have developed an eco-friendly nanocomposite -- using silver and red seaweed -- that is capable of penetrating these biofilms by killing microbes.

The new nanocomposite is composed of silver particles and Kappa Carrageenan (K-Carrageenan), a polymer derived from red seaweed, that is used as a gelling, thickening and emulsifying agent in foods. K-Carrageenan is also used instead of gelatin for those who don't want to eat meat-derived foods.

Researchers mixed K-Carrageenan with silver nitrate and irradiated it in a microwave synthesizer. The resulting substance was found to be effective against Gram-positive and Gram-negative bacteria.

"Capping of silver nanocomposites with K-Carrageenan imparts it stability and shelf life up to six months, which is one of the essential features of therapeutic formulations. The nanocomposite shows excellent antimicrobial activity against *S.aureus* and *Paeruginosa* bacterial biofilms," researchers said in the India Science Wire.

The new nanocomposite may also have applications for food packaging and wound dressings. "We are currently devising cost-effective anti-bacterial wound dressing materials and food packaging materials using the new nanocomposite. We plan to study its efficacy as potent anti-fungal and anti-viral agents too," said Krishna Mohan Poluri, a member of the research team.

Red seaweed mixed with nanosilver can help keep biofilms from fouling food and beverage machinery as well as medical devices.

Silver Industrial Demand Remains Strong

Silver's use in industrial applications, accounting for approximately 60% of total silver demand in 2018, is forecast to see a modest decline this year of 1.8% reaching 585.4 Moz, according to the GFMS / Silver Institute Interim Silver Market Review, which includes provisional supply and demand forecasts for 2018. The interim review was released in November at the Institute's Annual Silver Industry Dinner in New York City.

Demand for electronic and electrical applications is forecast to continue to drive robust growth, forecast to expand by 2.8% to 249.6 Moz in 2018. A general rise in electrical equipment has spurred the need for silver-coated circuity, wires and switches from a variety of end uses. Following the increased electrification of powertrains, the automotive sector is taking a lead in this development.

Global total physical demand is expected to contract by 3.0% to 963.0 Moz, with bar and coin demand being the main driver behind the fall, in 2018. New physical coin demand has remained under pressure this year, particularly in the United States during the first half of the year, as investors relied on the secondary market with older-dated coins for their investment needs.

The silver market is expected to post a physical surplus of 35.3 million ounces for 2018, which is higher than the previous year.

The report also noted:

• Net holdings of exchange traded products have contracted 0.5 million ounces as of November 15 following seven annual increases in the last decade. On the other hand, exchange inventories have increased for the third consecutive year in 2018, particularly on COMEX, which represents approximately 76% of total, rising by 52.5 million ounces.

• Following a drop of 1.5% in 2017, total silver supply for 2018 is forecast to marginally rise by 0.3% to 998.4 million ounces. The increase is solely driven by mine supply returning to growth this year, rising 1.6%, following declines in output recorded in the prior two years. At 5.4 million ounces, North America is forecast to shed the largest portion of supply which is offset by gains recorded in Oceania, Asia and Africa.

For more information visit the Silver Institute's website.

Artificial Nerve Cell Using Silver Moves Artificial Intelligence (AI) Forward

German and Italian scientists have produced a memristive element -- a component whose electrical resistance changes with the amount of current flowing through -- that functions similarly to a biological nerve cell. This discovery will help advance the science of artificial intelligence as the element, produced from nanowires, will allow computers to more closely approximate the neural networks of human brains. This could be a large step in the continuing development of artificial intelligence, and silver will play a key role

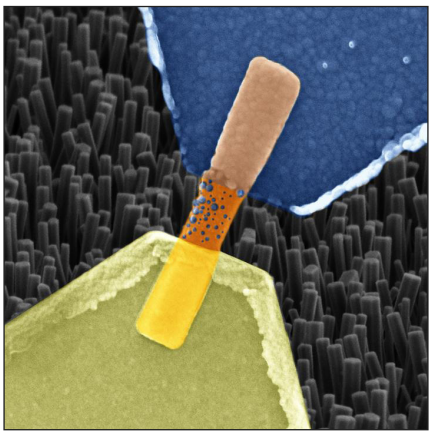
The element relies on silver to join it to other components, because silver is one of the world's best electrical conductors and is malleable enough to connect to the nanosized memristive element. The researchers believe that memristive cells may have the best chance of mimicking the function of human neurons and synapses in what they call 'bioinspired computers.'

In human neural networks, data is processed and stored at speeds too high for mechanical computer components to achieve. This had led engineers to try and mimic human brain networks by using animal cells (like those from bacteria) which are able to not only store great amounts of data but also process this data very swiftly, often in parallel. This network has the advantage of not only high speed and high storage but allowing one network to substitute for another if it breaks down -- in similar fashion to the human brain.

"With today's semiconductor technology, these functions are to some extent already achievable," said Ilia Valov from Forschungszentrum Jülich, one of the largest interdisciplinary research centers in Europe. "These systems are, however, suitable for particular applications and require a lot of space and energy. Our nanowire devices made from zinc-oxide crystals can inherently process and even store information, as well as being extremely small and energy efficient."

The nanowires are over a thousand times thinner than a human hair. Both ends of the nanowire must be attached to suitable metals, in this case platinum and silver.

Because single nanowires are still too small to be of practical value, the team from Jülich and the Polytechnic University of Turin hope to produce a larger memristive element composed of a great number of nanowires.



FORSCHUNGSZENTRUM JÜLICH

Image captured by an electron microscope of a single nanowire memristor (highlighted in color to distinguish it from other nanowires in the background image). Blue: silver electrode, orange: nanowire, yellow: platinum electrode. Blue bubbles are dispersed over the nanowire. They are made up of silver ions and form a bridge between the electrodes which increases the resistance.

RC Mint Offers 5-Ounce Silver Polar Bear Coin

The Royal Canadian Mint is offering a 5-ounce, 99.99% pure silver polar bear coin that uses 'virtual printing' around the edge to depict the jagged look of ice. The coin also shows engraved ice fragments around the bears and swirling waters that add to the Arctic theme.

The 1,200-mintage coin, designed by Tony Bianco, shows a mother bear and cub swimming. The obverse features wave-driven ice structures that frame the effigy of Her Majesty Queen Elizabeth II by Susanna Blunt. The face value is 50 dollars.

The retail price is CAN$579.95 or US$433.45 from the Royal Canadian Mint.

RC MINT

This 5-ounce, 99.99% coin from the Royal Canadian Mint depicts an Arctic theme.

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