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Silver News

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Silver Institute Presents at the London Bullion Market Association Global Precious Metals Conference

"… while the silver market is currently in a structural deficit, above-ground stocks of silver will be mobilized to meet the demand."

– Phillips Baker, President and CEO of Hecla Mining Company and Chairman of the Silver Institute.

The Silver Institute participated this month in a panel titled "Silver's Role in the Green Economy" at the prestigious London Bullion Market Association's Global Precious Metals Conference in Barcelona, Spain, which had over 850 delegates.

Phillips Baker, President and CEO of Hecla Mining Company and Chairman of the Silver Institute, along with the Institute's Executive Director, Michael DiRienzo, who moderated the panel, and Trevor Keel, Ph.D., the Institute's Technical Director, addressed the delegates about silver's role as an energy-transition metal.

Highlighting silver's important role in the application of solar energy, Mr. Baker underscored that silver's use in solar is not only vital to the application, but also that silver demand for solar use is projected to significantly grow for the foreseeable future. Dr. Keel emphasized that while there are efforts to thrift out of silver in this application, silver remains the critical ingredient in making the panels functional, and it will remain so for quite some time.

Turning to the global effort to increase electric vehicle (EV) usage, Mr. DiRenzo noted that EV growth in just the first quarter of this year in the United States increased 56 percent over the same period in 2022. Dr. Keel added that as the complexity of these vehicles continues to evolve, more silver will be required for their functionality.

Delegates asked Mr. Baker whether we will have enough silver for the green transition. He replied in the affirmative, explaining that while the silver market is currently in a structural deficit, above-ground stocks of silver will be mobilized to meet the demand. He added, however, that there are no new significant silver deposit discoveries at present, and that geopolitical issues and mine permitting delays continue to be encumbrances to bringing new sources of mined silver supply to market.

Spotlight on Wearables

Are Flexible Batteries that Utilize Silver in Our Future?

On the wish list of many wearables makers is a flexible battery that can twist and contort along with the fabric itself as the users go through their daily movements. This dream is a step closer according to a team of University of Houston (Texas) researchers who have developed a prototype of a fully-stretchable, silver fabric-based lithium battery.

The concept came from Haleh Ardebili, a professor of mechanical engineering. She said in a prepared statement: "As a big science fiction fan, I could envision a 'science-fiction-esque future' where our clothes are smart, interactive and powered. It seemed a natural next step to create and integrate stretchable batteries with stretchable devices and clothing. Imagine folding or bending or stretching your laptop or phone in your pocket. Or using interactive sensors embedded in our clothes to monitor our health."

The obvious problem is that when we think of batteries, we think of a device that is rigid and unbending. Moreover, batteries use a liquid or semiliquid electrolyte which causes safety concerns as the organic electrolytes are flammable. (See: Could a Composite of Minerals Including Silver Replace Lithium in Batteries?, June 2023, Silver News.)

The researchers focused on silver fabric as a platform for the flexible battery, according to Ardebili. She noted: "The weaved silver fabric was ideal for this since it mechanically deforms or stretches and still provides electrical conduction pathways necessary for the battery electrode to function well. The battery electrode must allow movement of both electrons and


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Professor Haleh Ardebili and Navid Khiabani, a UH graduate research assistant, discussing bendable batteries.

Ardebili and her team received several grants for their work including those from the U.S. National Science Foundation, U.S. National Aeronautics and Space Administration and the U.S. Army. Their work was published in Extreme Mechanics Letters this June, which noted that so far they have been able to bend the battery up to 15 percent without losing its ability to generate electricity. "Although we have created a prototype, we are still working on optimizing the battery design, materials and fabrication," she concluded.

Zapping with Microwaves Gives Higher Conductivity and Stability to Silver Imbedded in Wearables

The number of uses for silver nanowires is growing every day, but connecting these tiny wires together and imbedding them in flexible film for 'wearables' can yield inconsistencies. Moreover, as the wires approach atomic size their resistance increases, a phenomenon known as 'sheet resistance.' The more resistance, the less electricity is available for the application.

However, scientists at the Korea Institute of Industrial Technology say that a new method involving zapping the nanowires with microwaves gives a low resistance, distortion-free product that will increase the usage of silver nanowires in many medical and sports wearable devices.

Writing in the peer-review journal Scientific Reports the authors stated: "This innovative process effectively reduces the sheet resistance of the silver nanowire transparent conductive film without causing any thermal distortion to the [plastic] substrate." They added: "The microwave irradiation induces nanowelding between silver nanowires, leading to a decrease in sheet resistance by forming nanowelding junctions."

They continued: "Silver nanowires (Ag NW) have been recognized as a promising material for flexible transparent conductive films due to their excellent properties, such as high electrical conductivity, mechanical flexibility, good optical transparency, and low process temperature." They also noted that other methods used to lower sheet resistance, including placing the flexible sheet imbedded with silver in ovens, and treating with light and plasma, were unsatisfactory.

The microwave treatment is not without drawbacks, though. The film suffers from defects in surface roughness and weak adhesion, but scientists found that adding pressure along with microwaves mitigates these disadvantages. In conclusion they noted: "The pressure-assisted microwave process enables the easy embedding of silver nanowire conducting networks into the substrate, resulting in improved stability under bending deformation … making it a promising method for flexible electronic applications."

Silver-Based Sensors Help Measure the Tiniest Amounts of Dangerous Ammonium in Water

Ammonium is a building block of life – a vital part of the nitrogen cycle – but ammonium pollution in water poses a threat to the ecosystem and human health. Accurately measuring the amount of ammonium in the environment requires extremely precise measuring tools. To this end, scientists have developed a highly-sensitive electrochemical sensor for ammonium in water samples that relies on the incorporation of silver nitrate into a carbon paste.

Most ammonium in the environment comes from decaying organic matter. When nutrients from agricultural runoff or wastewater mix with this material, it can lead to the growth of harmful algae and a decrease in oxygen which is necessary for fish and other aquatic creatures to survive. More dramatic for humans is that ammonium negates some of the disinfecting abilities of chlorine which keeps drinking water in reservoirs safe. "For all these reasons, the determination of ammonium in drinking water is also of great importance to ensure its safety," the Egyptian researchers affiliated with Menoufia University and the National Water Research Centre wrote in the journal Scientific Reports.

Although other sensors have used silver in combination with different materials, this mixing of silver and carbon paste appears to be more sensitive than other tested sensors, the study authors noted. One reason is that more silver ions were deposited on the carbon paste than other materials and this offered greater opportunity for small amounts of ammonium to be collected and measured.

They concluded: "Overall, the method showed promising results for the determination of ammonium ions in natural waters and could be a potential candidate for the use of real-time deployable sensors."

Silver-Based Gel with Amino Acids 100 Times More Effective than Conventional Silver Drugs: Russian Scientists

As antibiotic drugs become less effective in fighting infections, typically due to overuse, remedies containing silver continue to show their promise. One of the latest entries comes from Russian scientists at Tver State University who claim that their antibacterial gel combining silver and amino acids is 100 times more effective at killing germs than current silver-based drugs such as those used for burn wounds.

Writing in the Journal of Materials Chemistry, the researchers noted that the production of this gel is inexpensive and non-toxic, another plus for this discovery as current methods to produce nanoparticles of silver often involve using chemicals that linger in the silver's structure.

In one experiment, they replaced these toxic precursors with sulfur amino acid, a substance found in humans. The amino acid reduces silver from its salts – silver nitrate, for example – yielding a gel that kept the silver structure intact.

The gel has been tested in the laboratory on a group of drug-resistant bacteria including *Staphylococcus* (commonly called 'Staph'), *Pseudomonas aeruginosa* (which causes pneumonia) and *Enterobacter*, which is very difficult to treat and can lead to dangerous conditions such as urinary tract infections (UTI), respiratory infections, and endocarditis (inflammation of heart tissues). These infections are often seen among hospital patients who were infected during their stay. "Our technology is simple, non-toxic and cheap enough to be easily scaled up," said head of the project Dmitry Vishnevetskii, associate Professor in the Department of physical chemistry at Tver State University, in a prepared statement.

"Due to this, it can be used in drug synthesis for the treatment of various diseases: acute, chronic, and hospital-acquired bacterial infections. In the future, we plan to test the gels on lab animals in order to determine the gel's safety and effectiveness."

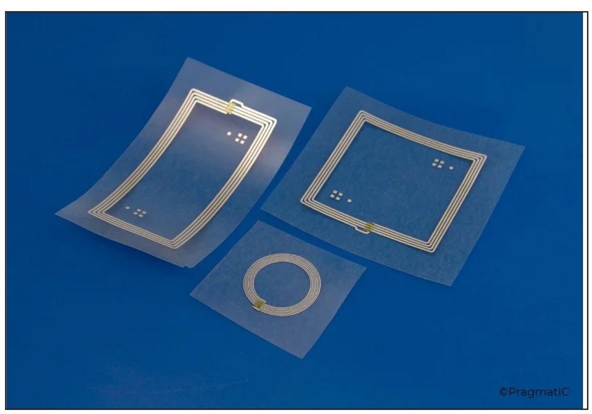
Recyclable Silver Ink Plays Prominent Role in 'Smart Packaging'

While printed electronics can be added to packaging to increase functionality like monitoring through Radio-Frequency Identification (RFID) tags – for inventory or theft control – they can make recycling of the packaging material difficult or even impossible. However, engineers in Wales have come up with a recyclable silver ink that makes recycling of the packaging material possible.

The proprietary and patent-pending technology relies on the ability to lower the amount of silver particles on the packaging while maintaining its conductivity and recyclability. This balancing act requires extreme precision, but if done correctly it will allow the packaging and the silver to be recycled in a cost-effective manner. The ink can be recovered from different packaging materials such as paper and plastic, and in one test 95 percent of the silver was recovered from uncoated paper.

The silver's properties were not degraded during recycling which means it can be remanufactured into new inks without additional processing.

"We envisage the ink being used in the creation of connected and intelligent packaging, including RFID aerials for IoT (Internet of Things) monitoring, capacitive touch sensors, sensor interconnects, and illumination in high-value packaging, all without the generation of electronic waste," said a spokesperson for the Welsh Centre for Printing and Coating (WCPC) based at Swansea University.



RFID antennas are often built into labels for packaging, but it can make paper recycling a challenge.

Silver Added to Non-Metal Catalyst Gives Greater Control of Chemical Reactions that Produce Many Consumer Products

In most cases, you want to speed up chemical reactions – such as when producing another commercial chemical or substance – by using a catalyst, but sometimes if the process moves too quickly, and you can lose control. Also, the catalyst gets used up more rapidly so the activation becomes costly. Now, Russian scientists have found that a mixture of iodine-derived organic salts and silver can reduce total catalytic activity on demand, giving the operator more control and the process more predictability, resulting in lower overall costs for catalysts.

One commonly-used group of catalysts are known as 'organocatalysts,' which are organic materials consisting of carbon, hydrogen, and other nonmetal elements that speed up chemical reactions. The advantage of using organocatalysts is that they can be isolated from the chemicals making up the reaction and can be used again. They are also nontoxic, can be prepared quickly, and stored longer, because they don't react with moisture in the air, which often happens to traditional catalysts made of metals. Think tarnish or rust.

Scientists from the Institute of Chemistry, Saint Petersburg State University, report in the journal ChemPlusChem that one such organocatalyst based on iodonium salts – which has many positive attributes like accelerating chemical reactions used to produce polymers for everyday consumer products such as smartphone cases and other plastic-like products – are difficult to control.

However, by adding silver, the reaction can be made more stable and predictable. "This factor should be taken into consideration while projecting chemical reactors," said Mikhail Il'in, assistant professor of department of organic chemistry at Saint Petersburg State University.

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