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Incorporating Copper Topics

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Edition #12

Copper – an Antiaging Element

Aging baby boomers may want to continue looking more like the "baby" than the "boomer," but although no one can stop the march of time, there are ways to hide its effects. New research has shown that adding trace amounts of copper to creams and lotions may help delay and even reverse the effects of the aging process.

The use of copper compounds for healing and beautification has ancient precedents. Queen Nefertiti, who ruled Egypt around 1350 B.C., started a fashion trend by painting her eyes with bold colors, including green from malachite, a copper oxide. This use might have been prompted by teachings at the time about copper's role in skin care and wound healing, which was cited in the *Ebers Papyrus*, the world's oldest known book, written in approximately 1550 B.C. Later physicians noted the use of copper compounds to treat skin diseases and infections in the *Hippocratic Collection* (460 to 380 B.C.), *De Medicina* (14-37 A.D) and *Pliney's Historia Naturalis* (23-79 A.D.).

SKIN REMODELING

Today, scientists are learning that the introduction of copper peptides (proteins containing copper ions) into the skin through creams and lotions dramatically improves skin tone and elasticity, according to Loren Pickart, Ph.D. He has been researching anti-aging processes since the 1970s and is credited with his work on the healing aspects of a peptide

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Tesla Electric Roadster – Powered by Copper

Electric-powered cars have long been a dream for sci-fi writers, energy producers and automotive enthusiasts. In concept, this goal seems easily attainable, but for years inventors, entrepreneurs, and manufacturers alike have tried and ultimately failed to design a reliable and economically attractive electric vehicle. While the recent introduction of gas-electric hybrids has brought the vision closer to reality, the all-electric automobile has steadfastly remained a distant point on our automotive horizon.

This may be about to change. In July, Tesla Motors, a three-year old startup company based in San Carlos, California, introduced a prototype of its first all-electric automobile, the Tesla Roadster. A true sports car, the Roadster is hand-built, sleekly designed, fast and nimble. It boasts a range of 250 miles with a top speed of 130 mph. The company plans an initial production run of 100 vehicles at a cost of $100,000 per car, with the first automobile slated for delivery in the summer of 2007. Tesla Motors is the first of a number of enterprising companies who are bringing electric automobiles to the marketplace.

The Tesla Roadster is also the first commercially available automobile to incorporate an electric motor powered by a copper motor rotor. This innovative advancement in metallurgical technology increases efficiency, resulting in greater overall power and longer operating distances between charges.

GONE BUT NOT FORGOTTEN

Tesla Motors takes its name from Nikola Tesla, a brilliant pioneer in electrical research. Tesla was fascinated by the potential of electric automobiles, and in 1930 he tested his theories with a car that achieved a top speed of 90 miles an hour. Unfortunately, he kept the design of his engine to himself, and the secret of his remarkable electric automobile died with him in 1943.

Even before Tesla, electric automobiles were not always absent from our roads. From the mid-1800s to the early twentieth century, electric cars were in high demand, and manufacturers like the Electric Car Company, Rauch & Long, and Detroit Electric produced thousands of vehicles a year to consumer

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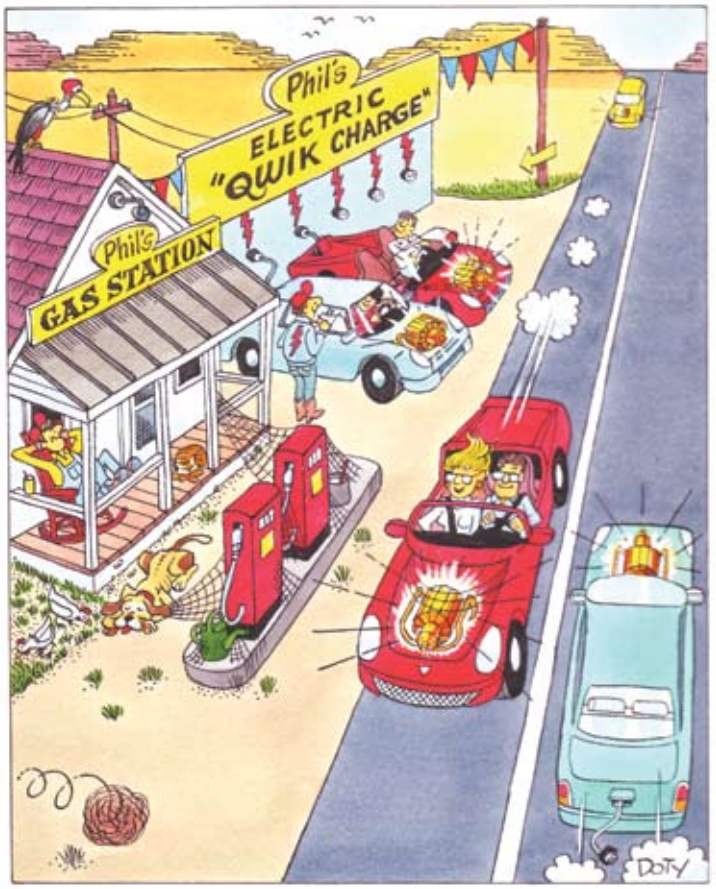


acclaim. Unfortunately, the power cells used then were rudimentary, difficult to recharge, and limited automobiles to low speeds and short traveling distances.

By the end of World War I, improvements in the design of internal combustion engines, combined with the widespread availability of gasoline following the war, led to the demise of electric automobiles. Consumer demand dwindled and the electric car faded into time – until our present era's growing energy crisis sparked renewed interest.

Over the past decade, demand for increased fuel efficiency and reduced dependence on fossil fuels has resulted in new developments in electric automobile research. Lithium-based battery technology offers substantial improvement over heavy, cumbersome lead-acid batteries, providing greater power with faster charging times. In addition, many vehicle manufacturers now produce gas-electric hybrids powered by both electric and standard combustion engines. On average, these vehicles consume about half the amount of gasoline required by a typical automobile, and drive up to 70 miles on a gallon of gas.

Still, almost two-thirds of all the oil consumed in the U.S. is used for transportation, while global demand for oil is skyrocketing and supplies are dwindling. These stark realities led Martin Eberhard and Marc Tarpenning, two Silicon Valley entrepreneurs with a knack for bringing inventive ideas to the marketplace, to create Tesla Motors. The men believe they will succeed because their Roadster is based on a technology unavailable, until now, to other electric vehicle manufacturers – a lightweight, highly efficient copper motor rotor.

COPPER ROTORS AND EFFICIENCY

Electric motors typically contain one or more magnets surrounding an armature, or rotor. When electricity is applied to the magnets, the positive and negative fields that result produce alternating current that turns the rotor, creating kinetic motion that is then directed through gears and shafts to the power train and the wheels.

One of the key advantages of copper is its electrical conductivity. Good conductivity equals higher efficiency, as less of the power generated by the motor is lost due to resistance and heat. Most electric motors today use aluminum rotors that are not as efficient, but are easier to mass produce and less expensive, than their copper counterparts. Ounce for ounce, a copper rotor requires less material, compared to an aluminum rotor, to achieve the same level of performance.

Although engineers have long known about the potential of copper rotors, manufacturing difficulties and cost stymied their efforts to produce a workable design. Now, following years of research in die-cast mold design, a copper motor rotor as efficient to produce as it is to operate has become a reality. The successful effort was led by the Copper Development Association in the USA, along with a number of corporate partners and the U.S. Department of Energy, and funded by the International Copper Association.

The Tesla Roadster's mobility is provided by a three-phase electric motor with a low-resistance copper "squirrel cage" rotor – a cylindrical rotating component that creates the vehicle's kinetic energy. While typical internal combustion engines weigh several hundred pounds, the Tesla electric motor weighs just 70 pounds. The motor is powered by a proprietary battery pack that uses lithium-ion technology, which is easily recharged by plugging into any standard 120-volt electrical outlet.

According to Martin Eberhard, "One of the most important criteria in the design of the Tesla Roadster is energy efficiency. We would not have been able to achieve such outstanding results without the use of a copper motor rotor. The rotor enables us to offer an electric motor with exceptional torque and power with minimal resistance losses – all key components in meeting our design and performance goals."

Tesla Motors rates the energy efficiency of the Roadster by calculating its "well-to-wheel" efficiency, using a ratio that compares the cost of producing and transporting the fuel source, the energy produced by its combustion in the engine, and the automobile's emissions, which negatively affect the rate. Well-to-wheel efficiency on the Roadster prototype was measured against a number of currently available sports cars and hybrids. The Tesla engineers found that the Roadster offers double the efficiency of today's hybrids while producing only one-third of the emissions. Testing also revealed that, on the road, the Roadster offers the same performance and acceleration as a high-end sports car while consuming only one-sixth of the total energy.

THE FUTURE OF TESLA AND COPPER

Tesla's initial production of 100 vehicles sold out within weeks and the company is already taking reservations for the next 100 vehicles to be built. Encouraged by this response, Tesla engineers are hard at work on a four-person sedan expected to debut in 2009.

"The electric car is a key to our energy independence and our future," Eberhard believes. "We expect copper to continue to lead the way for our high-performance electric automobiles." **Cu**

The Tesla Roadster (Top)
Tesla's electric motor mounted in the back of the automobile, features a copper motor rotor (Bottom).

complex called GHK-Cu (glycyl-l-histidyl-l-lysine:copper (II)), which is naturally found in the body.

"Copper peptides trigger a response that actually removes skin damage and replaces it with newer skin," he explains. Scientists refer to this improvement as "activating the remodeling process."

Pickart, who owns and distributes a skin cream product line, "Skin Biology," isn't the only one extolling the virtues of using copper peptides in creams to improve skin. Neutrogena®, a Johnson & Johnson product, introduced the "Visibly Firm" line of cosmetics containing copper peptides after studying its efficacy.

James J. Leyden, a professor of Dermatology at the University of Pennsylvania and founder of the school's Skin Study Center, conducted the study for Johnson & Johnson. He found that, "Products containing GHK-Cu, including a facial cream, eye cream and foundation, result in rapid improvement in skin condition, including reduction in the appearance of fine lines, wrinkles, roughness, sallowness (a sickly yellowish skin color), laxity and hyperpigmentation (brown spots)."

Skin elasticity, thickness and firmness were also improved. "GHK-Cu incorporated into skin care and cosmetic products is useful for improving the appearance of aging skin," adds Leyden.

"Copper is known to play a critical role in the integrity of connective tissue; it has been shown to stimulate collagen synthesis, critical to maintaining skin tone and firmness, and many publications have reported that copper positively affects wound healing ."

Some of the health and beauty products that contain copper.

WHAT'S AT WORK:

According to Pickart, at age five, 90 percent of our skin is comprised of collagen 3, which has strong elasticity and flexibility characteristics. This is what makes children's skin look so fresh and removes scars quickly. By age 60, only 10 percent of the skin is collagen 3, so its ability to naturally rejuvenate decreases with age. "GHK-Cu induces production of collagen 3, which allows the skin to be more soft and firm. It repairs the skin barrier, preventing allergens and bacteria from entering, and increases production of molecules that hold water in the skin, improving suppleness."

TIMING IS EVERYTHING

Boomers will be happy to hear that the Neutrogena study says improvements in skin firmness and overall appearance were visible within one week after using creams containing copper peptides. Fine lines were "significantly improved after two weeks" and coarse wrinkles looked better after eight to twelve weeks. Skin thickness increased an average of 17.8 percent after three months of twice-daily cream use.

Because cosmetics stay on the skin for many hours, they're a good way to deliver ingredients that can improve skin condition, says Yohini Appa, executive director of scientific affairs for Neutrogena. Improvements result from "the ability of the copper peptide complex to promote positive changes in skin microstructure, including increases in skin thickness."

ADDITIONAL USES

Cosmetics have always been a blend of artifice and science, and this latest revelation is little different. "Copper has something magical in it," Pickart observes. This "magic" extends beyond exterior beauty, however. Copper peptides have been found to be helpful in:

- Aiding skin healing after surgery, as well as after laser resurfacing, dermabrasion treatments and chemical peels
- Stimulating hair growth and hair transplants
- Improving skin conditions due to acne, diabetes and psoriasis
- Increasing the safety and efficiency of sun-tanning lotions, and reducing post-tanning skin peeling
- Reducing inflammation after men's shaving and encouraging new skin growth. **Cu**

Can Copper Increase Brainpower?

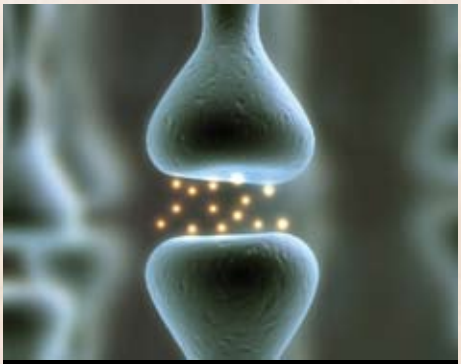
Recent research, at Washington University School of Medicine, has provided some intriguing insight into the role copper may play in how humans think.

The human body contains millions of neural synapses, or connections, that allow our nerves to "talk" to each other through chemical signals. Each synapse has antenna-like structures called NDMA receptors that control the strength and duration of these links. The researchers found that when a chemical signal reaches an NDMA receptor, the body reacts by releasing copper ions into the synapse to regulate the activity of the individual receptors.

How well these receptors perform their task appears to have a direct correlation on how long nerve cells live, as well as on our overall learning and memory capabilities.

"Why don't we think a hundred times better than we do?" asks primary researcher Jonathan Gitlin. "We've found that copper modulates very critical events within the central nervous system, and that influences how well we think."

Although the research is still in its infancy, scientists are excited by its potential. As they unlock the secrets of how our nervous system works, they hope to develop new treatments and therapies for those suffering from neurological disorders. **Cu**



A Synapse with NDMA receptors.

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Ultrahigh-speed Copper Ethernet Standard Approved

Ethernet cables with copper wiring.

A new Ethernet standard for low-cost, easy-to-use copper wiring capable of transmitting 10 gigabits per second (Gbps) of data – a tenfold increase in speed over current standards – has been announced by the Institute of Electrical and Electronics Engineers (IEEE). The standard was created to meet the burgeoning demands for bandwidth from IT professionals, content providers and consumers alike.

Ethernet is the most widespread local area network (LAN) technology in use today. It connects workstations, servers, personal computers and peripherals like scanners and printers and it allows multiple users to access and share these resources across an entire network. The first Ethernet consisted of copper coaxial cable and had a maximum speed of 2.94 megabits per second (Mbps). The IEEE later adopted a 10-Mbps standard in 1983, a 100-Mbps standard in 1995 and a 1-Gbps standard using twisted copper conductors in 1999. The new 10-Gbps standard is designed to be compatible with Category 6a or Category 7 communications wiring.

According to Brad Booth, president of Ethernet Alliance, "This is an exciting time for the Ethernet industry as there are a number of activities helping to drive the adoption of 10-Gigabit Ethernet (GbE). The growing deployment of 10-GbE standards-compliant equipment is generating demand for higher-speed Ethernet technology."

The 10-Gbps standard gives consumers a lot to look forward to in the future. More homeowners are taking advantage of Internet Protocol Television (IPTV), Video on Demand (VOD) and Voice over Internet Protocol (VoIP) services. With the additional bandwidth, the 10-Gbps standard provides for a whole new level of interactive content and functionality on copper cabling. **Cu**

Wind Power for Home Heating

Reducing fossil fuel consumption and energy costs are important for everyone. A group of engineering students at Oregon State University believes it can help by creating a home water heater powered by wind. Their novel approach uses rotating magnets and a copper plate to produce thermal energy.

"Copper is the most efficient metal for our heater because of its conductivity," says Jacques Chiron who, with fellow student Paul Vigansky, created the water heater for their senior project. "The more we can do to help lower fossil fuel consumption, the better. Also, we use recycled copper, which makes the heater even more environmentally sound," says Chiron. Water heating, he points out, is one of the biggest consumers of energy.

The students' heater uses a small outdoor turbine that turns when the wind blows, spinning a shaft with an aluminum disk at the base end. Several magnets are attached to this disk, which rotates near the surface of a copper plate measuring a foot square and a quarter-inch thick. The rotating magnets create an electrical current in the copper, which causes the plate to heat up. Attached to the plate is 3/8-inch-diameter copper tubing. Water flowing through this tubing is heated and sent to a holding tank. In a home, this stored hot water can be used for typical domestic purposes, such as showering, washing dishes and hydronic heating.

"A control box continuously monitors the temperature of the water," Chiron explains. "When it's hot enough, the plates separate to stop the heating. When it's colder, the plates are brought into closer proximity." Water temperatures have reached 140 degrees Fahrenheit in tests, he adds. The turbine can also be turned by water current to create hydroelectric power.

Because sufficient wind and water power are not always available, they "might not be a home's sole source of hot water," says Chiron. "But this method could reduce electric bills considerably.

"We wanted to prove the concept that moving magnets in front of copper would create electrical current by heating up copper because the energy has nowhere else to go," Chiron adds. The students based their experiment on a prototype envisioned by a former teacher, the late Alan Wallace, and they are considering patenting the process and marketing this type of heater. **Cu**

Jacque Chiron and Paul Vigansky with the wind-powered water heater.

(Photo Courtesy of OSU)

RESOURCES:

This edition of Discover Copper is also available online at www.copper.org and at www.homeplanningnews.com.

For more information on the topics mentioned in this newsletter go to:

Tesla Motors – http://www.teslamotors.com/

Oregon State College of Engineering – http://eecs.oregonstate.edu/index.html

Ethernet Alliance – http://www.ethernetalliance.org/home

Washington University School of Medicine – http://medicine.wustl.edu/

Skin Study Center – http://www.skinstudy.com/