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SPARC WEEKLY

A LUCKY LAB ACCIDENT PRODUCES SPIDER-MAN-LIKE SILK

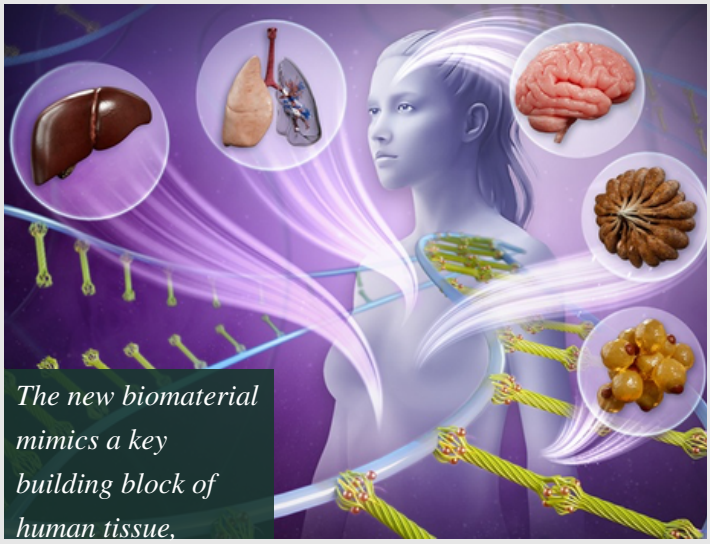
Researchers have created a new adhesive material inspired by Spider-Man's silk, marking the first time an adhesive can stick to and lift objects from a distance. This innovative material is dispensed from a syringe as a liquid, which quickly hardens into a strong, sticky thread capable of lifting objects up to 80 times its own weight. In laboratory tests, the material successfully lifted various items, including a wood block, steel nuts, and a test tube.

The development of this material was a collaborative effort involving Marco Lo Presti, a researcher at Tufts University in Medford, Massachusetts, and Fiorenzo Omenetto, who directs the Silk Lab where Lo Presti works. They teamed up with chemists from the University of Bari in Italy, including Gianluca M. Farinola, who referred to the project as the "Spider-Man experiments." The discovery of this super-strong adhesive was somewhat accidental. Lo Presti was initially working on creating an adhesive that could stick securely underwater. He started with silk moth cocoons, which are boiled to produce liquid silk, and mixed in a chemical that mimics the sticky substance mussels use to attach to underwater rocks. While cleaning his lab equipment with acetone, Lo Presti noticed that his silk mixture rapidly solidified, resembling a spider's web. This unexpected result led to the idea of creating a "web shooter" to disperse the material. The team has created various silk recipes for different applications, such as making the thread stronger or stickier.

While the material isn't ready for crime-fighting, it has potential uses in biomedical engineering and as a biodegradable alternative to plastic-based adhesives. The discovery was likened to Peter Parker's accidental acquisition of superpowers, and the team hopes to make products more sustainable using silk-based glues.

https://www.snexplores.org/article/spider-man-silk-sticky-web-shooter
https://advanced.onlinelibrary.wiley.com/doi/10.1002/adfm.202414219

NOVEL 'LIVING' BIOMATERIAL AIMS TO ADVANCE REGENERATIVE MEDICINE



The new biomaterial mimics a key building block of human tissue.

Researchers at Penn State have developed a novel biomaterial called acellular nanocomposite living hydrogels (LivGels) that mimics the behavior of biological tissues and extracellular matrices (ECMs). ECMs are the body's natural scaffolding that supports tissues and cells, and replicating their properties has been a challenge in materials science. The new material, published in Materials Horizons, overcomes limitations of previous synthetic hydrogels by combining self-healing properties and the ability to mimic ECMs' response to mechanical stress, such as nonlinear strain-stiffening (where materials stiffen under strain).

The LivGels are made from "hairy" nanoparticles composed of nanocrystals (nLinkers) with disordered cellulose chains ("hairs") at their ends. These nanoparticles bond with a biopolymeric matrix of modified alginate, a natural polysaccharide from brown algae. The dynamic bonds formed by the nLinkers enable the material to exhibit strain-stiffening behavior and self-healing properties, closely resembling natural ECMs. Unlike previous synthetic hydrogels, LivGels are entirely bio-based, avoiding potential biocompatibility issues.

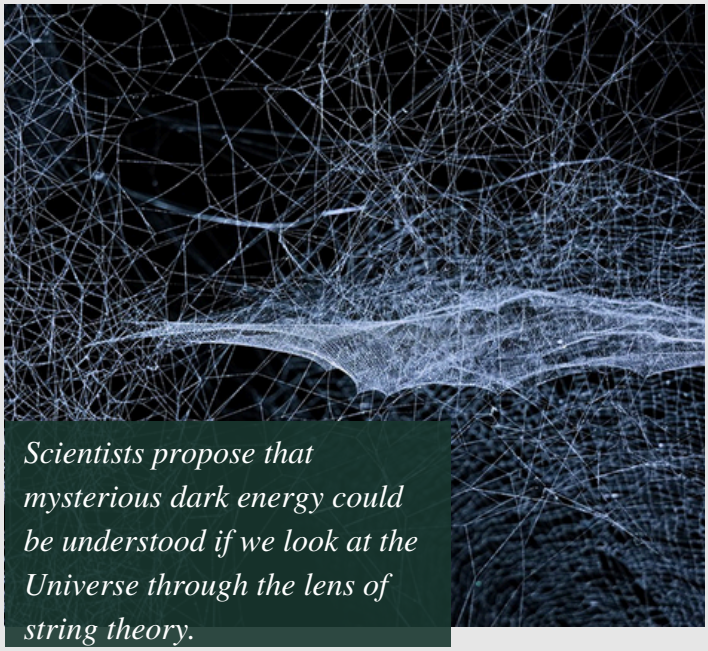
The material's mechanical properties can be finely tuned to match those of natural ECMs, making it suitable for a range of applications. These include:

- *Regenerative medicine: Scaffolding for tissue repair and regeneration.*
- *Disease modeling: Simulating tissue behavior for drug testing and studying disease progression.*
- *3D bioprinting: Creating customizable hydrogels for tissue engineering.*
- *Soft robotics: Developing devices with adaptable mechanical properties.*

The researchers used rheological testing to demonstrate the material's rapid recovery after high strain, confirming its dynamic and responsive nature. Future steps involve optimizing LivGels for specific tissue types, exploring in vivo applications, integrating them with 3D bioprinting platforms, and investigating their use in wearable or implantable devices. This breakthrough could significantly advance fields like regenerative medicine, disease modeling, and soft robotics.

https://www.sciencedaily.com/releases/2025/02/250206155347.htm
https://www.hospimedica.com/critical-care/articles/294803981/novel-living-biomaterial-to-advance-regenerative-medicine.html
https://pubs.rsc.org/en/content/articlelanding/2025/mh/d4mh00922c

A “DARK DIMENSION” COULD HELP EXPLAIN THE ORIGIN OF DARK ENERGY



Scientists propose that mysterious dark energy could be understood if we look at the Universe through the lens of string theory.

Theoretical physicists Ivano Basile and Dieter Lüst propose that string theory could help solve one of cosmology's biggest mysteries: the surprisingly small density of dark energy, the mysterious force driving the accelerated expansion of the universe. Dark energy, which doesn't interact with light, has eluded direct detection and remains poorly understood. The current explanation—that it arises from quantum vacuum fluctuations—faces a major problem: calculations predict a dark energy density 10^120 times larger than observed, a discrepancy known as the cosmological constant problem.

Basile and Lüst suggest that string theory, which posits that fundamental particles are one-dimensional strings vibrating in higher dimensions, could resolve this issue. String theory requires 10 dimensions (9 spatial and 1 temporal), with the extra dimensions traditionally thought to be extremely small (Planck-sized). However, the researchers propose that one of these extra dimensions—dubbed the "dark dimension"—could be much larger, around a micron in size (10^-6 cm). This larger dimension would significantly alter the energy density calculations, bringing them in line with the observed value of dark energy.

Their study, published in Progress of Physics, explores how a micron-sized dark dimension could reconcile string theory with the observed dark energy density. If correct, this would imply that the quantum gravity scale—the energy at which gravitational interactions become quantum mechanical—is much lower than previously thought, potentially making it accessible to future high-energy particle colliders like the proposed Future Linear Collider at CERN.

While the findings are promising, they are preliminary and require further refinement. The exact shape and properties of the other compactified dimensions remain unknown, and more detailed models are needed to match increasingly precise observational data. If validated, this theory could revolutionize our understanding of the universe, making quantum gravity experimentally testable and opening new avenues for exploring string theory and dark energy.

https://www.advancedsciencenews.com/a-dark-dimension-could-help-explain-the-origin-of-dark-energy/
https://arxiv.org/abs/2409.12231

CAN WE CONTROL GENETIC INHERITANCE? NEW RNA STUDY SUGGESTS IT MIGHT BE POSSIBLE

Researchers discovered new pathways for dsRNA entry into cells, revealing how RNA influences gene regulation across generations

A groundbreaking study published recently, by researchers at the University of Maryland offers new insights into RNA transport and its potential to revolutionize RNA-based drug development. RNA-based therapies, such as double-stranded RNA (dsRNA) treatments, hold great promise for precisely targeting and silencing disease-causing genes. However, efficiently delivering these RNA molecules into cells remains a significant challenge.

Using microscopic roundworms as a model, the research team discovered multiple pathways for dsRNA uptake in cells, challenging previous assumptions about RNA transport. They found that dsRNA can carry instructions not only between cells but also across multiple generations, shedding light on how gene expression changes can be inherited.

A key protein, SID-1, which facilitates dsRNA transfer, was shown to play a role in regulating gene expression across generations. Surprisingly, when SID-1 was removed, the worms became more efficient at passing gene expression changes to their offspring, with these changes persisting for over 100 generations even after SID-1 was restored.

The study also identified a gene called sdg-1, which regulates "jumping genes"—DNA sequences that can move or copy themselves within a chromosome. While jumping genes can introduce beneficial genetic variations, they often disrupt existing sequences and cause disease. The sdg-1 gene, located within a jumping gene, produces proteins that control jumping gene activity, creating a self-regulating loop that maintains genetic stability. This delicate balance prevents excessive gene movements that could harm the organism.

The findings have significant implications for human medicine. Proteins similar to SID-1 exist in humans, and understanding how they control RNA transfer could lead to better-targeted treatments for diseases and potentially influence the inheritance of certain disease states.

Understanding RNA transfer mechanisms may lead to better treatments for diseases and even influence inherited conditions. The research opens new avenues for designing effective RNA-based medicines and studying heritable gene regulation.

https://scitechdaily.com/can-we-control-genetic-inheritance-new-rna-study-suggests-it-might-be-possible/
https://elifesciences.org/articles/99149

WHO ARE WE?

SPARC Robotics Team's mission and vision is to make our environment the best it can be. On a volunteer basis, we look at the problems that are happening around us and make them our problems, both as SPARC and individually, and help as much as we can with appropriate projects. NASA ACCP (Astro Camp Community Partners) was only in the US until four years ago. This year they came to Turkey with us after four years of traveling to many countries. ACCP educates school-age children from kindergarten to high school on science-related topics of interest with practical knowledge and application, while also supporting children's craft development, general culture and questioning skills. As SPARC, we have brought this training provided by NASA to our country in the most comprehensive way and our continuous communication with NASA not only enables us to improve our trainings day by day, but also gives us the opportunity to learn about the innovations in the field of STEM instantly, from the most accurate source and to spread the knowledge we have around us.

EDITOR

Dear reader,

Greetings from SPARC Weekly, in which we gather latest scientific news.

We would be delighted to hear your comments or suggestions and we encourage you to write to us if you have any views or opinions on the stories in SPARC Weekly. We look forward to hearing from you.

Have a nice week and enjoy the magazine.

Defne Şehidoğlu and Reyhan Doğanca