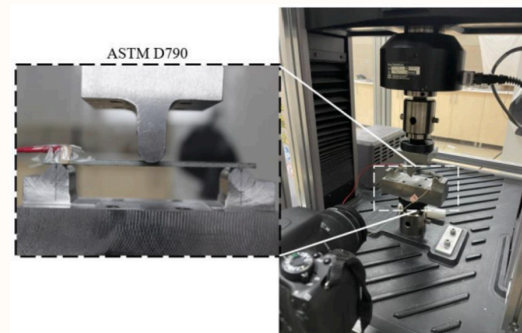


# Research Bulletin

July 2025

## NEW METHODS DEVELOPED FOR DAMAGE DETECTION IN HYBRID COMPOSITES

An important study was conducted on the damage mechanisms in hybrid composite materials. These materials, which combine different fibers such as carbon, basalt, and aramid, were highlighted as critically important for sectors like aerospace and automotive. The study examined the effect of strain rate on damage formation. Using acoustic emission techniques, the analyses revealed that increasing strain rates altered the types of damage and that peak frequency served as the main indicator. These findings provide valuable insights for the design of high-performance composites.



Gulsen, A., Kolukisa, B., Eteci, M., Caliskan, U., Zafar, H. M. N., Demirbaş, M. D., Özdemir, A. T., & Bakir-Güngör, B. (2025). Investigating strain rate effects on damage mechanisms in hybrid laminated composites using acoustic emission. *Applied Acoustics*, 240, Article 110931. <https://doi.org/10.1016/j.apacoust.2025.110931>

## INEQUALITIES IN ACCESS TO URBAN AMENITIES EXPLORED IN STOCKHOLM

Table 1 | Summary statistics of variables used in the analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
House Prices (Log)	89,969	12.537	0.581	6.665	15.178
Wages (Log)	89,969	10.199	0.441	2.332	12.247
Water	89,969	0.010	0.0494	0	1
Commercial	89,969	0.017	0.084	0	1
Residential qualities	89,969	0.478	0.290	0	1
Parks	89,969	0.031	0.049	0	0.506
Non visible minorities	89,969	0.891	0.098	0.263	1
Highly Educated	89,969	0.369	0.105	0.129	0.963
Road Networks	89,969	0.309	0.142	0	1
Distance Center	89,969	0.214	0.135	0.000	1.005
SqrMeter	89,969	96.990	44.960	10	300
Type of House	89,969	4.003	1.332	1	6

A comprehensive study was conducted to examine inequalities in access to urban amenities in Stockholm. The research revealed imbalances in the distribution of both natural and designed features that affect quality of life. According to the findings, the primary driver of inequality in the city is social segregation. Urban design and the availability of natural amenities were also found to contribute to the disparity. These results can guide policymaking toward more equitable and inclusive cities.

Michelangeli, A., Östh, J., Toger, M., & Türk, U. (2025). Inequality in access to urban amenities. *Nature Urban Sustainability*, 5(1), Article 54. <https://doi.org/10.1038/s42949-025-00248-2>



# CINNAMON EXTRACT-INFUSED WOUND DRESSINGS ACCELERATE HEALING

A new wound dressing material was developed to accelerate healing and prevent infections. Electrospun poly(lactic acid)/gelatin membranes were enriched with various concentrations of cinnamon (*Cinnamomum zeylanicum*) extract. The resulting membranes were chemically, morphologically, and mechanically characterized. They exhibited antibacterial and anti-inflammatory properties and demonstrated a 42% improvement in wound closure. This study suggests that the cinnamon extract-infused membrane holds promise as an innovative and effective wound dressing material.

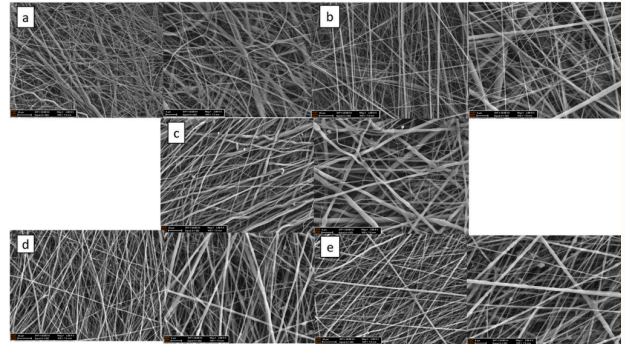


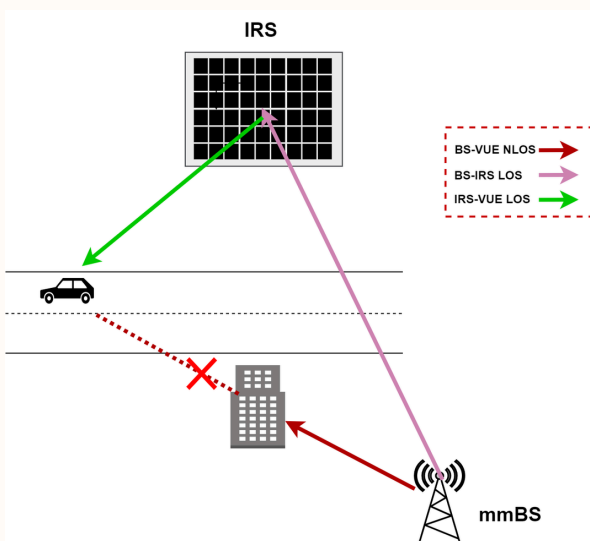
Fig. 4. SEM micrographs of electrospun membranes: a) Raw (without extract), 1000x/2000x; b) CE1, 1000x/2000x; c) CE5, 1000x/2000x; d) CE7.5, 1000x/2000x; e) CE10, 1000x/2000x. The scale bars indicate 10  $\mu$ m and 4  $\mu$ m, respectively.



Tarhan, S. Z., Pepe, N. A., Sen, A., & Işoğlu, I. A. (2025). *Cinnamomum zeylanicum* extract incorporated electrospun poly(lactic acid)/gelatin membrane as a new wound dressing. *International Journal of Biological Macromolecules*, 320, Article 145837. <https://doi.org/10.1016/j.ijbiomac.2025.145837>

## SEAMLESS COMMUNICATION WITH INTELLIGENT SURFACES IN MILLIMETER WAVE TECHNOLOGY

A new artificial intelligence algorithm was developed to enhance communication between vehicles and infrastructure. Aimed at overcoming the challenges of millimeter wave (mmWave) technology in urban environments, the system integrates intelligent reflecting surfaces (IRS) capable of sensing their surroundings. By utilizing real-time traffic and vehicle movement data, the algorithm significantly improved signal connections. Simulations demonstrated that this innovative approach can enhance performance up to four times compared to existing methods. This advancement paves the way for safer and smarter transportation networks.



Suarez del Valle, R., Köse, A., & Lee, H. (2025). Context-aware beam selection for IRS-assisted mmWave V2I communications. *Sensors*, 25(13), Article 3924. <https://doi.org/10.3390/s25133924>



## A NEW ERA IN BRAIN TUMOR DIAGNOSIS WITH AI SUPPORT

To accelerate the early diagnosis of low-grade gliomas (LGG), new artificial intelligence-supported methods were explored. Using Magnetic Resonance Imaging (MRI) data, three different deep learning models were compared. The Super Vision UNet and Transformer UNet models were found to delineate tumor boundaries with greater precision compared to traditional methods. These findings offer promising potential for speeding up LGG diagnostic processes and improving their accuracy. The approach may reduce radiologists' workload and minimize diagnostic errors.

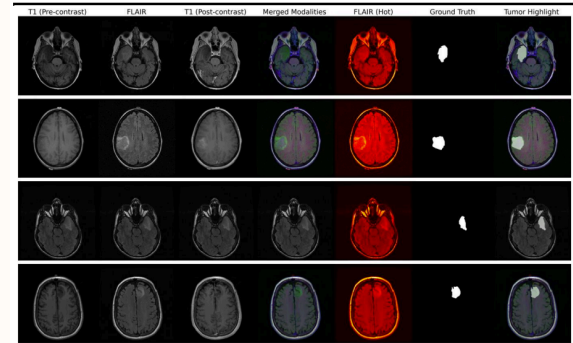
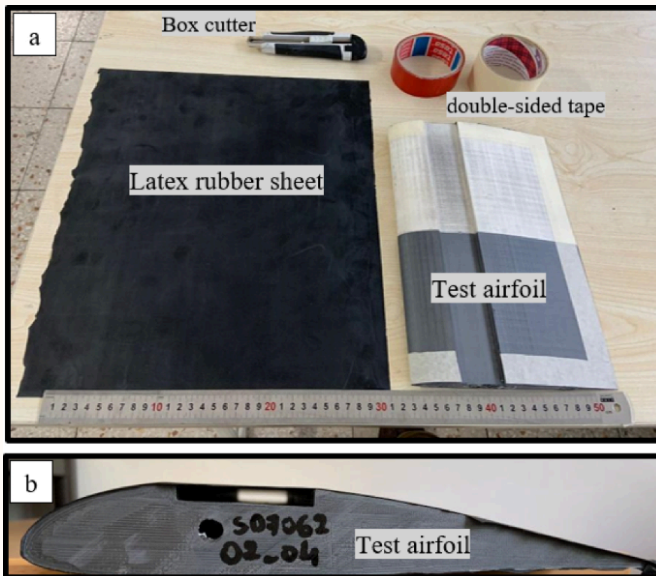


Figure 1. Visualization of multimodal brain MRI scans from five patients diagnosed with low-grade glioma. Each row represents a different patient. The columns show: (1) T1-weighted (pre-contrast), (2) FLAIR, (3) T1-weighted (post-contrast), (4) a merged visualization of the three modalities, (5) FLAIR with a hot colormap for enhanced contrast, (6) the ground truth tumor mask, and (7) the tumor region overlaid on the merged image.



Güzel, Y., & Aydın, Z. (2025). A comparative study of UNET variants for low-grade glioma segmentation in magnetic resonance imaging. *İnönü Üniversitesi Sağlık Bilimleri Dergisi*, 13(2), 344–355. <https://doi.org/10.33715/inonusaglik.1677185>

## INNOVATIVE METHOD DISCOVERED TO ENHANCE WIND TURBINE EFFICIENCY



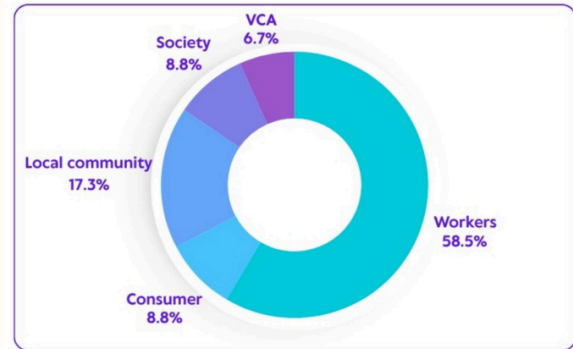
An innovative flow control method was investigated to improve the blade performance of low-speed wind turbines. The study experimentally examined the airflow characteristics over turbine blades using a flexible membrane material. Measurements revealed that the membrane's flexibility delayed flow separation and triggered the transition to turbulence, thereby improving airflow over the blades. These findings highlight significant potential for increasing wind energy efficiency.

Koca, K., Keskin, S., Şahin, R., Veerasamy, D., & Genç, M. S. (2025). Measurements of flow characterization revealing transition to turbulence associated with the partial flexibility-based flow control at low Reynolds number. *Journal of Bionic Engineering*, 50(12), 9061–9077. <https://doi.org/10.1007/s13369-024-09349-z>



# NEW CRITERIA SET FOR SOCIAL SUSTAINABILITY IN THE TEXTILE INDUSTRY

A comprehensive study was conducted to enhance social sustainability in the textile sector. Despite its significant role in the global economy, the industry's social impacts have long been overlooked. In this research, criteria outlined by the United Nations were adapted specifically for the textile industry. New social indicators were established, including quality, women's rights, gender wage gaps, and circular economy practices. These findings aim to strengthen social responsibility awareness within the textile industry and support its transition toward greater sustainability.



Fidan, F. Ş., Kızılkaya Aydoğan, E., & Uzal, N. (2025). Comprehensive analysis of social subcategories throughout life cycle assessment approach for the textile industry. *The International Journal of Life Cycle Assessment*, 30(6), 1464–1479. <https://doi.org/10.1007/s11367-024-02340-8>

## HIGH-TEMPERATURE PERFORMANCE OF NEXT-GENERATION CONCRETES EXAMINED

The behavior of fly ash-based geopolymer concretes under high temperatures was thoroughly investigated. As an eco-friendly alternative to traditional cement, the performance of this material under extreme conditions was analyzed. Experimental results showed significant mass loss and approximately 80% reduction in compressive strength in samples exposed to 800°C. Microstructural analyses revealed the formation of cracks, voids, and pores with increasing temperatures. These findings provide critical insights for the safe and reliable use of geopolymer concretes in high-temperature applications.

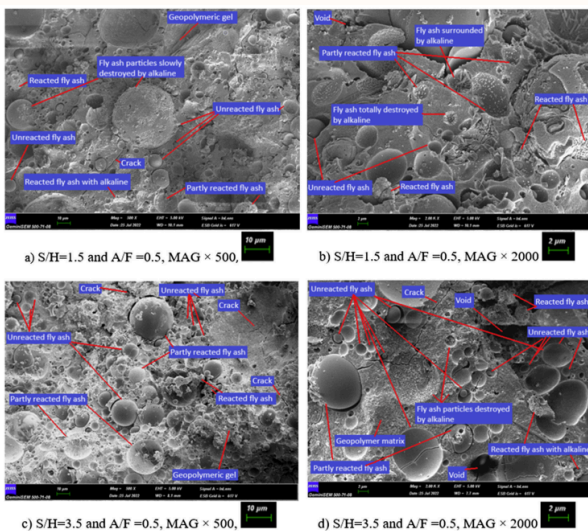


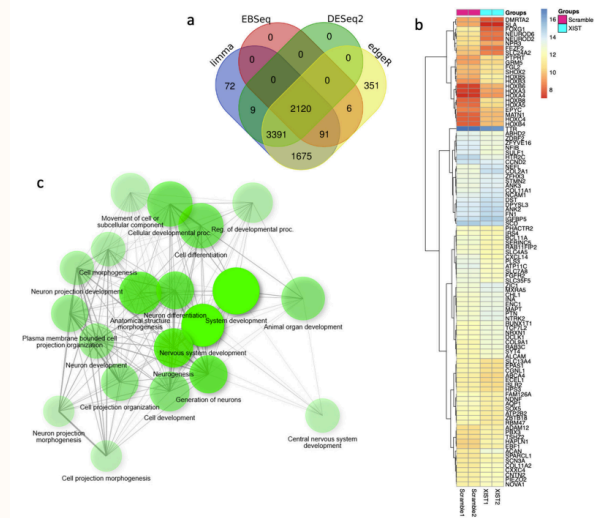
Fig. 4 SEM images of GPC with  $S/H = 1.5$  and  $3.5$  and  $A/F = 0.5$  at ambient temperature

Küçüköncü, H., & Özbayrak, A. (2025). Microstructural analysis of low-calcium fly ash-based geopolymer concrete with different ratios of activator and binder under high temperatures. *Journal of Bionic Engineering*, 50(11), 8197–8223. <https://doi.org/10.1007/s13369-024-09266-1>



# GENDER DIFFERENCES IN BRAIN DISORDERS BROUGHT TO LIGHT

A new therapeutic target has been identified in the treatment of neuroinflammatory diseases such as Multiple Sclerosis (MS). The role of the long non-coding RNA XIST was examined in brain organoids, focusing on its impact on neuroinflammation and myelination processes. Silencing XIST was found to alter the expression of genes related to neural development, inflammation, and myelination. This suggests that XIST may contribute to the sex-specific progression of MS and could serve as a potential treatment target. The findings are expected to open new pathways for drug discovery in neurological disorders.

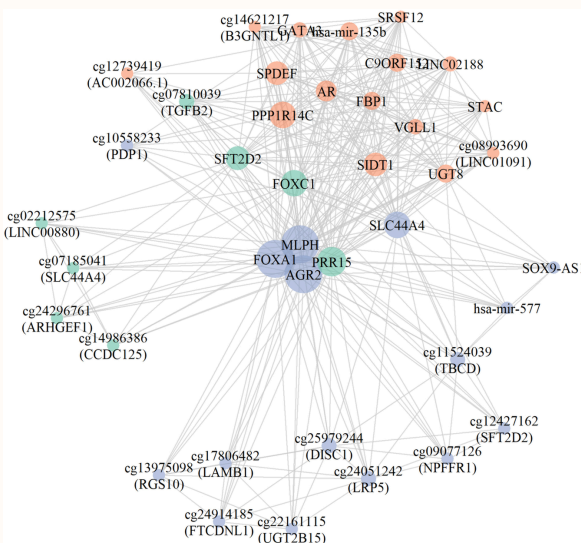


Aktas Pepe, N., Acar, B., Ertürk Zararsız, G., Ayaz-Guner, S., & Sen, A. (2025). Role of Long Non-Coding RNA X-Inactive-Specific Transcript (XIST) in neuroinflammation and myelination: Insights from cerebral organoids and implications for multiple sclerosis. *Non-Coding RNA*, 11(3), Article 31. <https://doi.org/10.3390/ncrna11030031>



# NEW AI TOOL DEVELOPED FOR BREAST CANCER TREATMENT

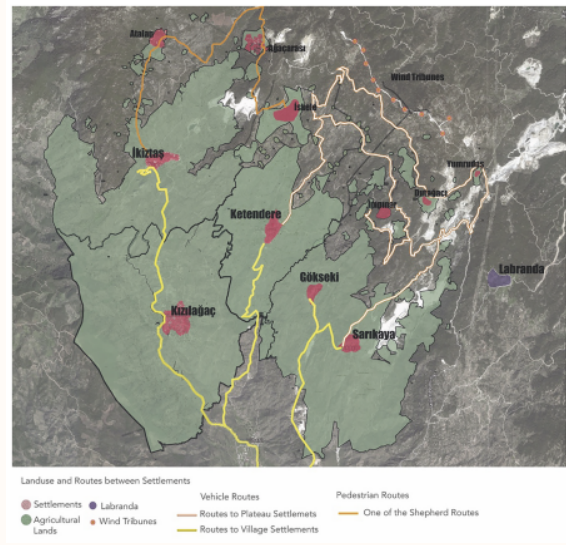
A novel artificial intelligence tool named 3Mont has been developed to design effective treatment strategies for different subtypes of breast cancer (BRCA). This tool integrates various “omics” data (such as genomic and proteomic) to identify promising biomarkers for distinguishing cancer subtypes. Compared to existing tools, the method operates 20% faster and achieves a 92% accuracy rate in subtype classification. This advancement significantly contributes to the development of personalized treatment approaches for breast cancer.



Ünlü Yazıcı, M., Marron, J. S., Bakir-Güngör, B., Zou, F., & Yousef, M. (2025). 3Mont: A multi-omics integrative tool for breast cancer subtype stratification. *PLoS ONE*, 20(6), Article e0326154. <https://doi.org/10.1371/journal.pone.0326154>

# A NEW CONSERVATION APPROACH PROPOSED FOR ÇOMAKDAĞ'S RURAL HERITAGE

A recent study in the Çomakdağ region proposes a new approach for the sustainable preservation of rural heritage. The research reveals that the interaction between traditional lifestyles and architecture has been transformed by economic changes and technological developments. Despite these evolving conditions, researchers emphasize the critical importance of maintaining the connection between daily life and the built environment. Multidimensional analyses at the building, settlement, and regional scales offer new perspectives for developing sustainable conservation strategies.

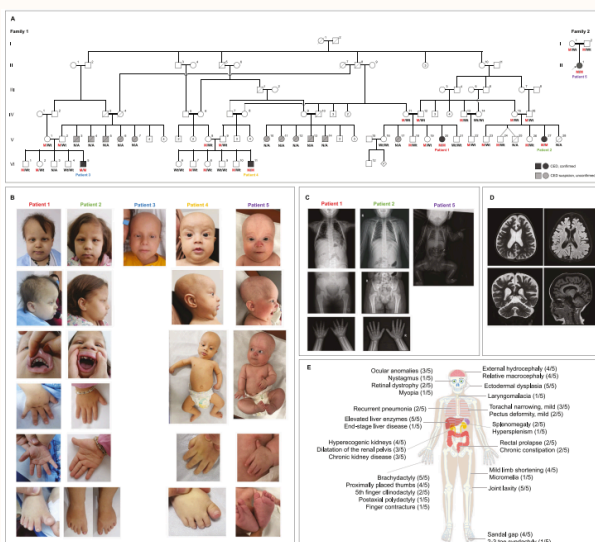


Kurtuluş, V. B., & Şahin Güçhan, N. (2025). Sustainable conservation through the interrelations between rural architecture and life: The case of Çomakdağ. *Journal of Cultural Heritage Management and Sustainable Development*. <https://doi.org/10.1108/JCHMSD-04-2023-0035>



# GENETIC CAUSE OF A RARE DISEASE DISCOVERED

A new genetic cause of the rare condition cranioectodermal dysplasia (CED) has been identified. Researchers found that a homozygous frameshift variant in the *CILK1* gene leads to the development of CED. This previously unknown genetic link was studied in five patients. Functional data from patient-derived cells revealed that the variant disrupts cellular structures. The study identifies *CILK1* as the first non-IFT protein-coding gene associated with CED etiology, broadening the diagnostic and therapeutic landscape for the disease.



Sezer, A., Öner, Ş. S., Saat, H., Turan, M. G., Gungor, T., Cevik, S., Erol, A., Yeniser, F., Catalbas, K., & Ozbakir, D. H. (2025). A homozygous frameshift variant in the *CILK1* gene causes cranioectodermal dysplasia. *Journal of Human Genetics*. <https://doi.org/10.1038/s41431-025-01902-0>

# NANOSTRUCTURES AIM FOR HIGH EFFICIENCY IN THIN-FILM SOLAR CELLS

A study was conducted on the use of nanostructures to achieve high optical absorption in thin-film solar cells. The research aims to overcome the limitations of conventional flat-surface designs. By integrating nanocolumns onto the surface of semiconductor thin films, light-trapping efficiency was significantly enhanced. Simulations showed that these nanocolumns absorb light more effectively, leading to a notable improvement in the overall performance of solar cells. This advancement is expected to contribute to the development of clean energy technologies.

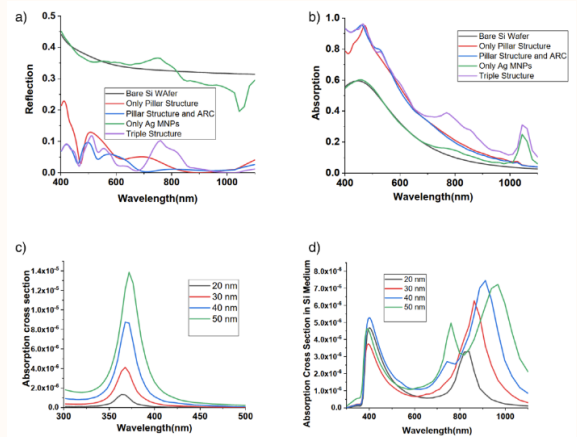


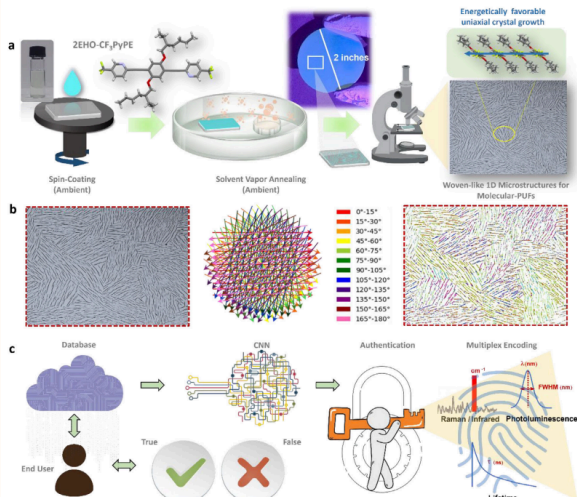
Figure 4. a) Reflection spectrum from the surface for four different cases. b) Total absorption spectrum in the Si bulk of 1.0 micrometer depth. c) Local plasmonic peaks of Ag MNP in air. d) Hybrid plasmonic peaks in Si material.

Tut, T. (2025). Achieving high optical absorption in thin film photovoltaic devices via nanopillar arrays and metal nanoparticles. *Advanced Theory and Simulations*. <https://doi.org/10.1002/adts.202500702>



# NEW MOLECULAR SECURITY SYSTEM DEVELOPED AGAINST COUNTERFEITING

To ensure object authenticity and prevent counterfeiting, an ultra-high-capacity encoding system was developed using thin films composed of a single type of molecule. These molecular structures self-assemble through hydrogen bonding to create random, fabric-like patterns that generate unique identity codes. Offering low-cost production and scalability, this system holds the potential to revolutionize security technologies.



Kayaci, N., Kiremitler, N. B., Deneme, İ. O., Kalay, M. U., Ozbasaran, A., Zorlu, Y., Onses, M. S., & Usta, H. (2025). Stochastic orientational encoding via hydrogen bonding driven assembly of woven-like molecular physically unclonable functions. *Advanced Materials*. <https://doi.org/10.1002/adma.202506067>



# QUANTUM BATTERY EFFICIENCY ENHANCED WITH NEW CONTROL METHOD

A new control method has been developed to improve the efficiency of next-generation energy storage systems—quantum batteries. An experimental study was conducted on a model designed to optimize the charging process. It was found that controlling the connection between the battery and the energy source exponentially increases charging efficiency. The simple method proved effective across both low and high temperatures. This advancement is expected to contribute significantly to the development of more powerful quantum batteries.

Borisenok, S. (2025). Open-loop control on the efficiency of quantum battery with reservoir engineering. *Journal of Physics: Conference Series*, 14(1), 19–24. <https://doi.org/10.35470/2226-4116-2024-14-1-19-24>

