Dreamarks

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MAGAZINE

What is Antimony

Today, 50% of global antimony production comes from China. Previously, it was mass-produced in France from 1718 to 1914. This metal, containing silver and aluminum, is useful in the textile, paint, pottery, microelectronics, semiconductor, and machine-building industries.

IN THIS ISSUE

Dreamarks Magazine

About Dreamarks

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Antimony is a metal that has many uses, even since the 17th century it has been developed for the treatment of leishmaniasis which is transmitted by sandflies.

The Nature of Atomic Entity

Each of our cells is a self-contained unit with its own life function. Likewise, every element in the universe has its own essence as an entity. Take antimony, for example, which you can find in cell phones, microprocessors, laptops, and various other semiconductors scattered around us. Little known, this metal has a multitude of uses, much like a cheap new type of gold. Yet, this material has had diverse uses since the 17th century. Many mothers are unaware that this component is a key ingredient in eyeshadow, medicine, paint, carving, and pottery.

Speaking of innovation at the cellular level, since 2018, China has begun developing Azobenzene EPC, as Micro Wearables or Synaps Memristors, or coatings for nerve stem cells in our brains, similar to prosthetic hands or feet that protect and reconnect life functions that have been damaged or interrupted due to autoimmune diseases like multiple sclerosis or other causes. Many other developments are still open.

Another news item is the innovation of a headphone device with an infrared laser that can detect possible strokes. We hope this inaugural edition of Dreamarks captivates readers and encourages them to look forward to the various upcoming editions. No day without innovation.

Gina Al Ilmi

Editor-in-Chief

ANTIMONY

Will production in France return?

Antimony is widely used in nanoelectronics as a semiconductor material. It has its own classification in the periodic table and is widely imported from China. However, due to export restrictions, several parties in France are considering reviving this antimony mine. In the high-tech industry, when this metal, known as Stibium, is combined with selenide to form Stibium Selenide or Antimony Selenide (Sb2Se3), it has high infrared and photovoltaic sensitivity.

By Los Alamos National Library | Photography by Heritage Auctions

ANTIMONY

Brief History & Usability

Antimony has been widely known to humans since the 17th century for various purposes. Due to its toxicity, this element can be dangerous.

One of its victims, the famous classical composer Wolfgang Amadeus Mozart, is said to have been diagnosed with excess antimony in his blood at the time of his death. We already know that Mozart died at a very young age, and now we know the element that ended his life.

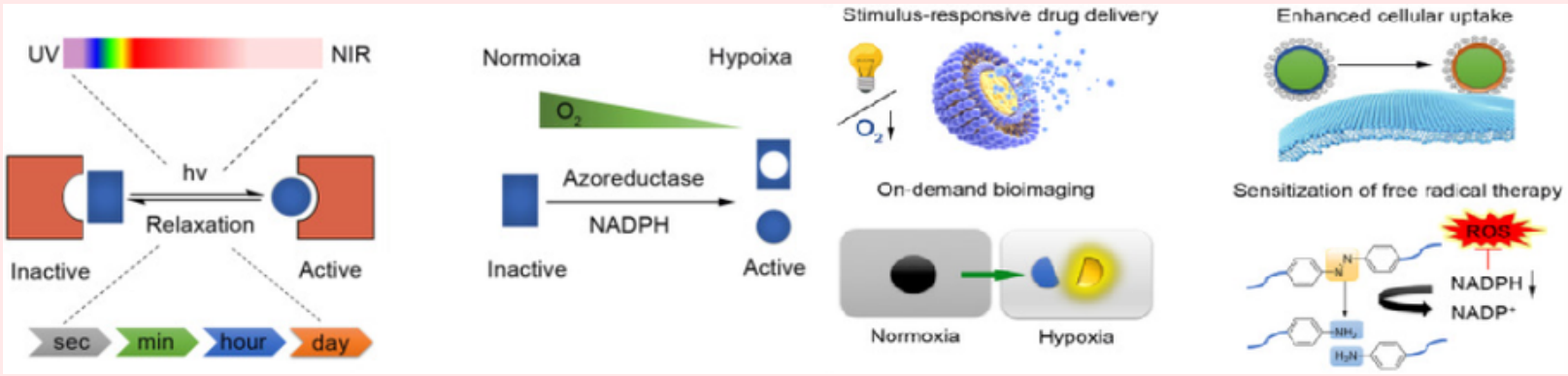
But did you know that antimony is a familiar element in our daily lives? From simple crafts with artistic production methods such as paint, pottery, carvings, and so on.

Even in cosmetics, such as eye shadow, which contains antimony. Element 55 in the periodic table is also known as stibium. When combined into stibium selenide (Sb2 Se3), this malleable metal is widely used in the high-end electronics industry, especially in the manufacture of semiconductors.

Because it is considered cheap and easy to shape, Antimony Selenide, which reflects infrared waves, is very good for assembling in micro electronic components.

France once had at least three antimony mines scattered across several locations. Since the 17th century, these French antimony mines supplied up to 50% of the world's antimony needs. However, due to cheaper antimony from China, these mines were eventually closed and no longer active.

History of Azobenzene Usage for Medicine



Azobenzene (Azo) was first synthesized by Mitscherlich in 1834. Gerhard Domagk successfully treated streptococcal infections in humans using an azo dye (Prontosil) in 1932, sparking research into azo-based antimicrobials.

Although many drugs have been withdrawn from the market, some antibacterial and anti-inflammatory drugs, such as salazosulfapyridine and balsalazide, remain in clinical use today.

Due to concerns about the carcinogenicity of azo-based dyes, the medical development of these dyes was delayed for a long time.

However, with advances in photopharmacology, nanotechnology, and nanoarchitecture, azo-based systems have been reintroduced into biomedical and pharmaceutical sciences to address various unmet clinical needs.

The surge in azobenzene's interest in medical research is primarily due to its unique structure, which allows for photoisomerization and bioreduction.

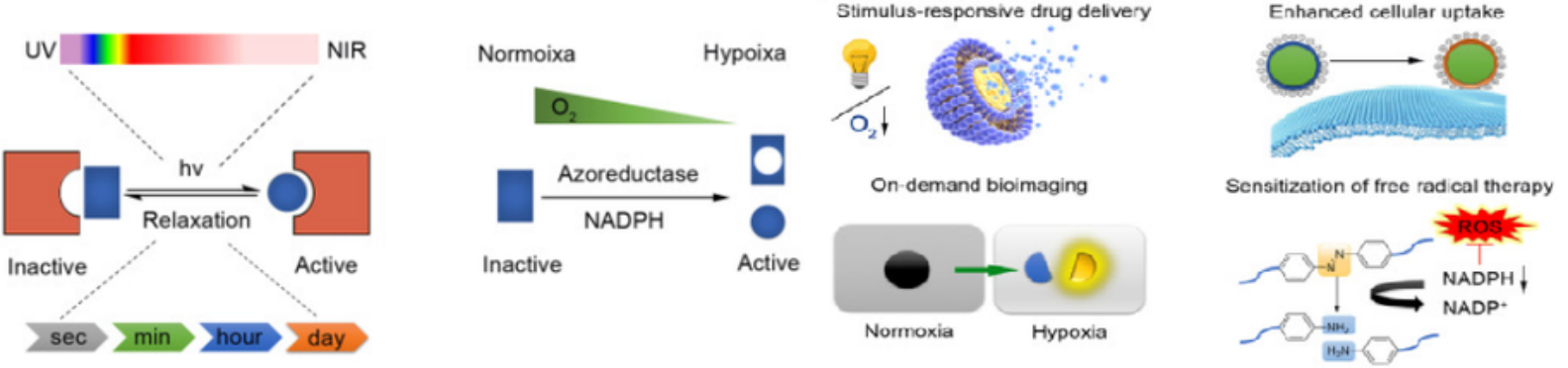
Aobenzene usage in various biomedical disciplines has been extensively reviewed. Azobenzene photoswitches can be used to photocontrol the structure and function of proteins, including G-protein-coupled receptors, receptors and ion channels, kinases, and proteases.

sSpecifically, azobenzene has been integrated with proteolysis-targeted chimeras (PROTACs) for light-controlled degradation of target proteins.

Azobenzene is also popular for precisely manipulating the biophysics of lipid membranes (e.g., fluidity and permeability). Furthermore, azobenzene has been used to modify nucleic acids for photoregulation of gene expression and enzymatic reactions.

Approaches to shift the activation light of azobenzene toward the red are also discussed. Azo-based polymers have been reviewed in terms of structure, synthesis, assembly, and response to light. Among the broad pharmaceutical and biomedical applications of azobenzene, prodrugs and drug delivery systems are two of the most prominent areas.

Use of Azobenzene in Internal Body Drug Delivery System



Azobenzene is unique compared to other photoresponsive moieties and delivery systems because it is susceptible to multiple triggers, including light, hypoxia, and enzymes. These properties allow for the engineering of multifunctional systems for pharmaceutical and biomedical applications.

Furthermore, azobenzene moieties can be readily conjugated with small molecules and macromolecules. The activity and function of azo-based prodrugs and in-body drug delivery systems (DDSs) developed can be triggered by UV light, a benefit typically applicable to topical diseases due to poor tissue penetration of UV light.

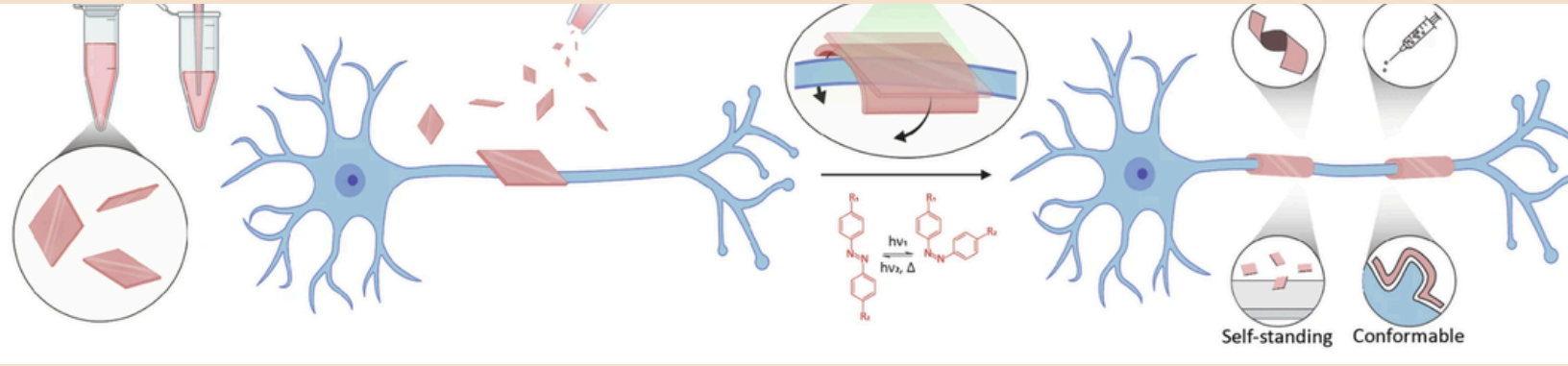
Although the synthesis, assembly, and biomedical applications of azobenzene-based materials have been previously reviewed, the current work aims to summarize and analyze recent advances in addressing light-, hypoxia-, and enzyme-responsive prodrugs and drug delivery systems with azobenzene as the primary building block.

Azobenzene-based photoswitched prodrugs can avoid side effects caused by nonspecific biodistribution of active pharmaceutical ingredients. Typically, the trans isomer of the prodrug is inactive by design, while the cis isomer exhibits pharmacological activity. Light irradiation can be directly applied to the lesion site to activate the prodrug for site-specific local therapy.

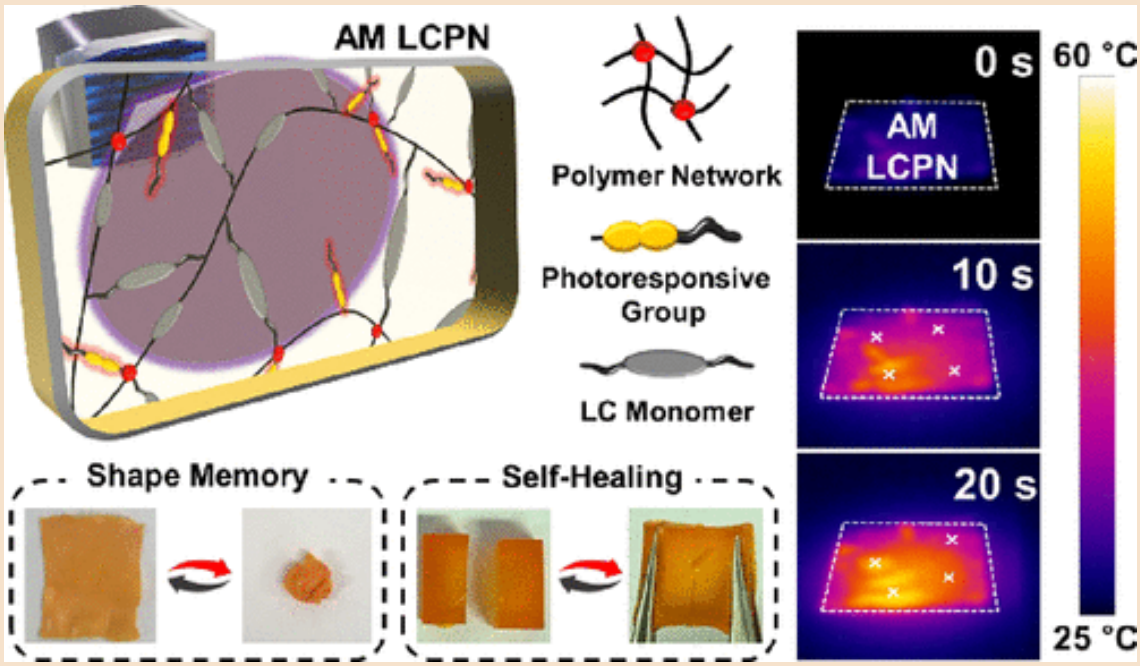
Stimuli-responsive drug delivery systems (DDSs) have been designed to achieve controlled payload delivery at the lesion site. As a highly responsive moiety, azobenzene can respond to light, hypoxia, and specific enzymes.

Photoisomerization and bioreduction of azo-modified vehicles can induce changes in the size, porosity, and surface chemistry of the vehicles to modulate cellular uptake and payload release. In particular, azo-based DDSs have received increasing attention in the antitumor and antimicrobial fields.

The Function of Azobenzene Polymers in The Medical World



2009 has been developed in Japan, 2018 began to be developed in China, now in 2024 in America, Azobenze is now a polymer element that is being developed as Micro Wearables because it has the ability to coat nerve cell stems that have been damaged or severed in the brain, which is caused by a disease such as an autoimmune disease in Multiple Sclerosis sufferers.



Previously, in 2022, azobenzene polymers were developed in Korea, which are responsive to stimuli and can align cells, thus enhancing self-healing capabilities. These components are stimulus-responsive liquid crystal polymer networks (LCPNs), which are sensitive to ultraviolet (UV) light and can induce photochemical isomerization. This isomer bond formation is important for helping the body in old age or those who have lost their ability to regenerate or self-heal due to disease.

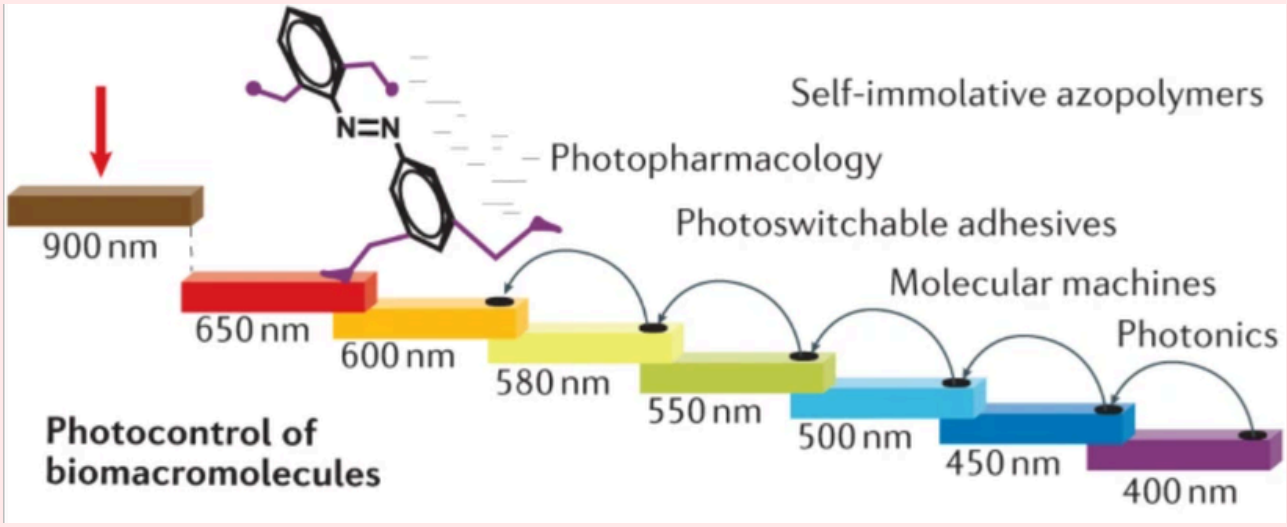
Azobenzene Polymers as The New Biomacromolecules Gold Mine

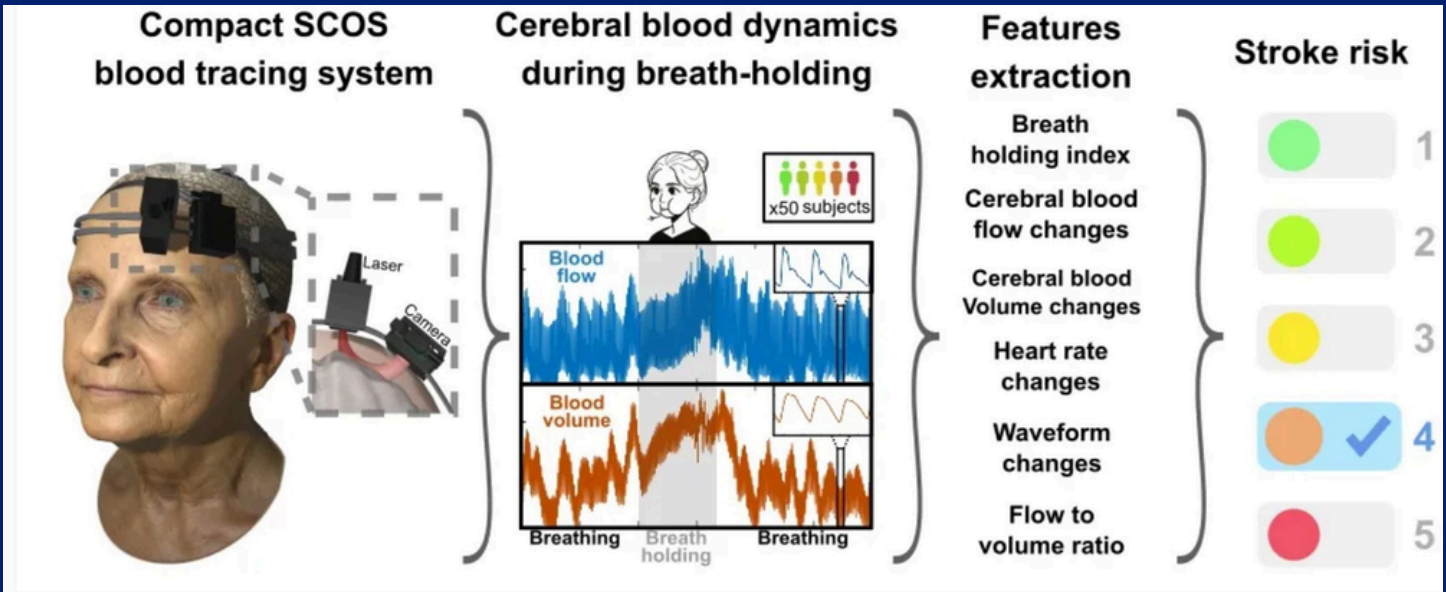
Azobenzene is an archetypal molecule that plays a leading role in both basic and applied research. For nearly two centuries, the field of azobenzenes has witnessed significant achievements; it has evolved from a simple dye into a 'small engine' and has become ubiquitous in many aspects of our lives, from textiles, cosmetics, food, and medicine to energy and photonics.

Despite its long history, azobenzene continues to generate academic interest, while being intensively produced for industrial purposes, due to its rich chemical properties, versatile and easy design, robust photoswitching process, and biodegradability.

The development of azobenzenes has stimulated the production of new colored and light-responsive materials with a wide range of applications, and their use continues to expand into new high-tech applications.

Synthesis of infrared light-responsive azobenzenes and emerging application areas include photopharmacology, light-sensitive adhesives, and biodegradable materials for intracellular drug delivery. The synthetic flexibility and adaptive properties of azobenzene continue to inspire new research and development directions, including in the fields of photo-pharmacology, molecular machines, photonics, and photoswitchable adhesives.





Researchers tested the new device on 50 volunteers who were split between high- and low-stroke risk. After one minute, the participants were asked to hold their breath, causing blood to rush to the brain. The headset device used SCOS to measure changes in blood flow and volume. Based on those measurements, the device was able to successfully differentiate between low- and high-risk participants. (Huang et al., Biomedical Optics Express)

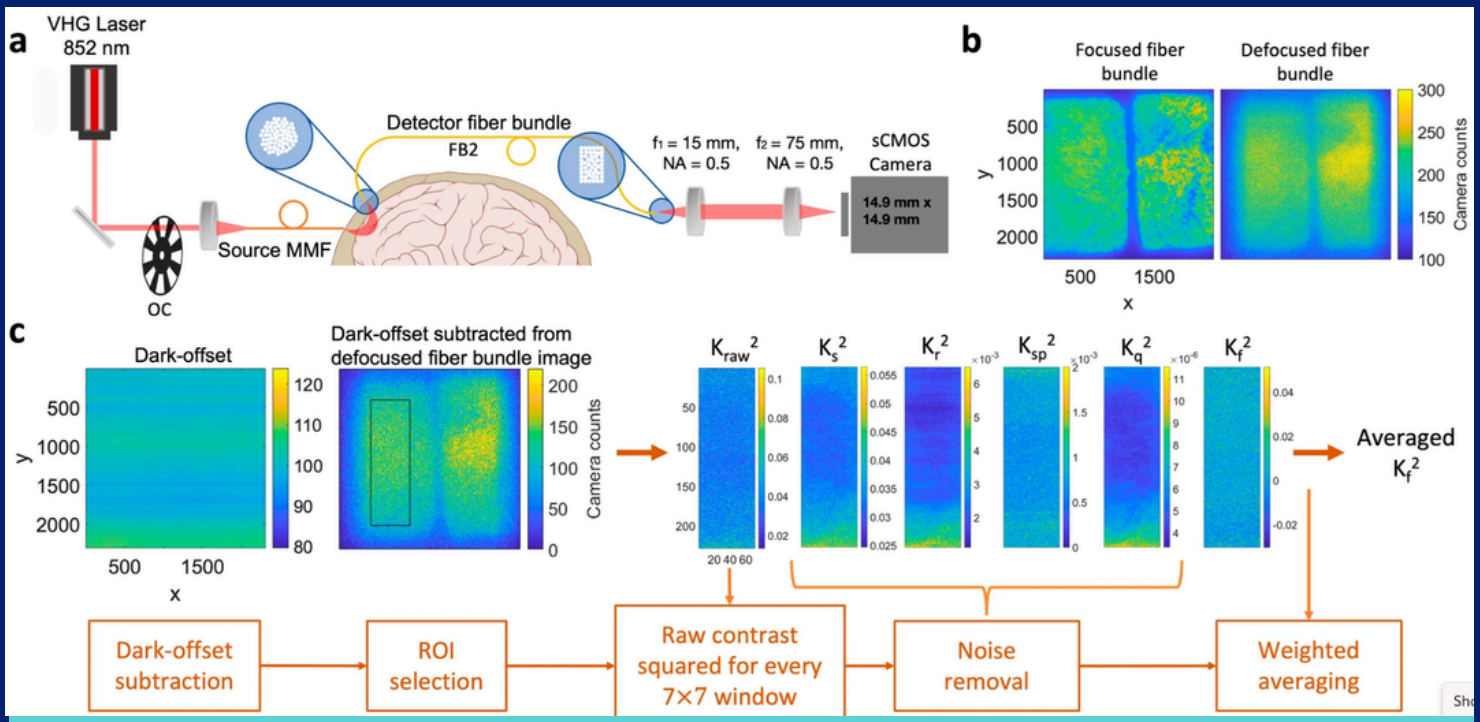
NON INVASIVE *Stroke Detector*

MAHLER & HUANG (2024) FROM CALTECH HAVE DISCOVERED A NEW METHOD TO DETECT THE POSSIBILITY OF A STROKE BEFORE IT HAPPENS, BY CREATING SPECKLE CONTRAST OPTICAL SPECTROSCOPY (SCOS)

Cerebral blood flow (CBF) is crucial for brain health. Speckle contrast optical spectroscopy (SCOS) is a technique recently developed by Kim, B., Zilpelwar, S., Sie, E.J. et al. (2023) to measure CBF, but the use of SCOS to measure human brain function at large source-detector separations with comparable or greater sensitivity to cerebral blood flow than extracerebral has not been demonstrated.

We describe a fiber-based SCOS system capable of measuring human brain activation-induced CBF changes at 33 mm source-detector separation using a CMOS detector. The system employs a pulsing strategy to increase photon flux and utilizes a data processing pipeline to improve measurement accuracy.

We show that SCOS outperforms the current leading optical modality for measuring CBF, diffuse correlation spectroscopy (DCS), achieving a SNR improvement of over 10x at similar financial cost. Fiber-based SCOS provides an alternative approach to functional neuroimaging for cognitive neuroscience and health science applications.



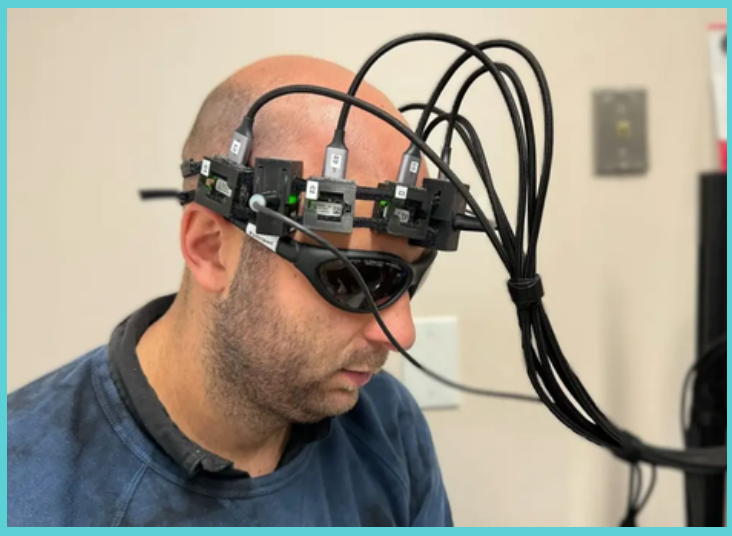
SCOS Set Up & Data Analysis Online

Monitoring Stroke from Cerebral Blood Flow

Cerebral blood flow (CBF) is an important indicator of brain health because it regulates oxygen delivery to the brain and the removal of metabolic wastes such as carbon dioxide. Changes in CBF correlate with serious clinical conditions such as ischemic stroke, traumatic brain injury, and Alzheimer's disease.

CBF also provides information about brain function, as neural activation induces hemodynamic changes through neurovascular coupling.

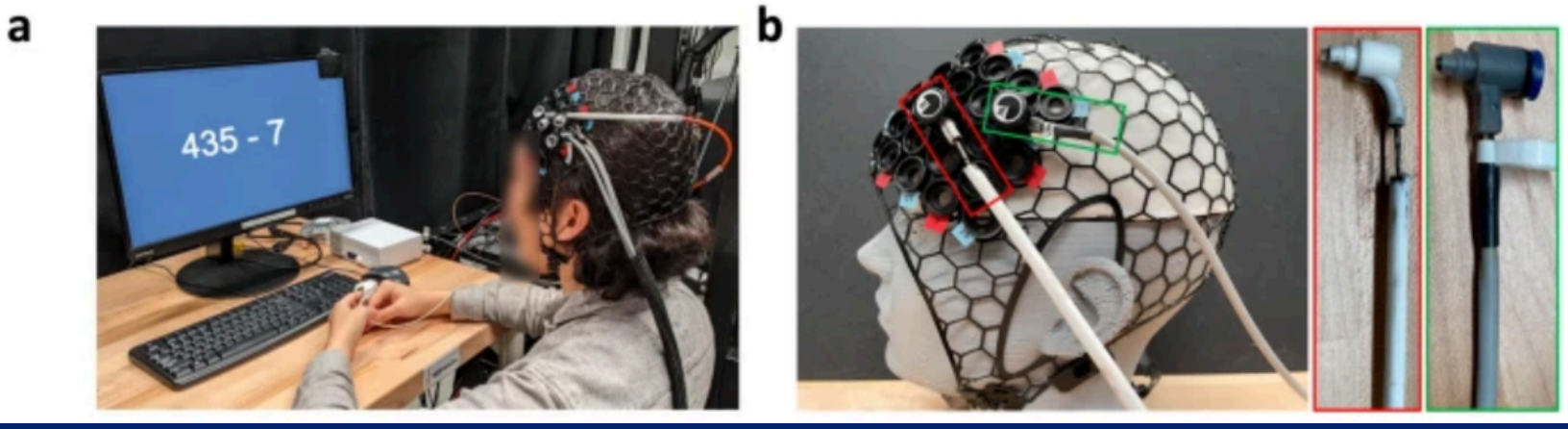
Therefore, according to Kim, B., Zilpelwar, S., Sie, E.J. et al. (2023), CBF monitoring is essential for cognitive neuroscience studies as well as clinical applications. Diffuse correlation spectroscopy (DCS) is an optical technique that measures human CBF from coherent light re-emitted from tissue.



Blood flow index (BFi), a metric that is linearly correlated with underlying blood flow, is calculated from the decorrelation time of the autocorrelation function of the time course of spot intensity.

SCOS offers a convenient way to monitor CBF non-invasively and continuously at the bedside, a measure not achievable with other techniques such as positron emission tomography and arterial spin-labeling magnetic resonance imaging.

Fig. 6: Mental subtraction measurements using fiber-based SCOS.

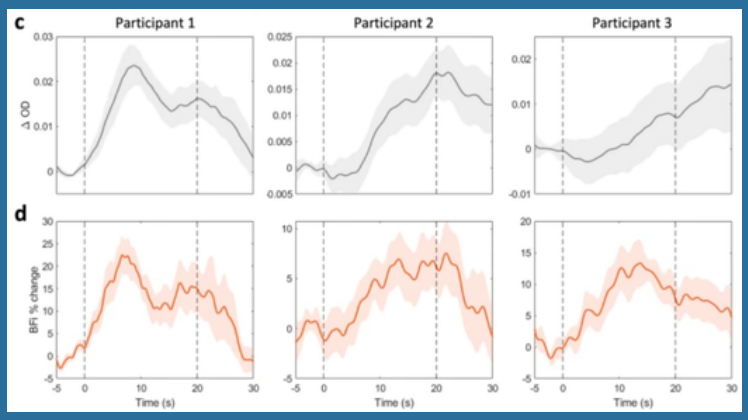


Brainwave Monitoring in Mathematical Operations

In addition to measuring a number of critical bodily functions in health, researchers have also discovered another use for SCOS: measuring and monitoring human brain waves while performing mental arithmetic operations.

Kim, B., Zilpelwar, S., Sie, E.J. et al. (2023) used an existing high-density fNIRS system to locate the activation region on the forehead with the largest task-averaged change in total hemoglobin concentration.

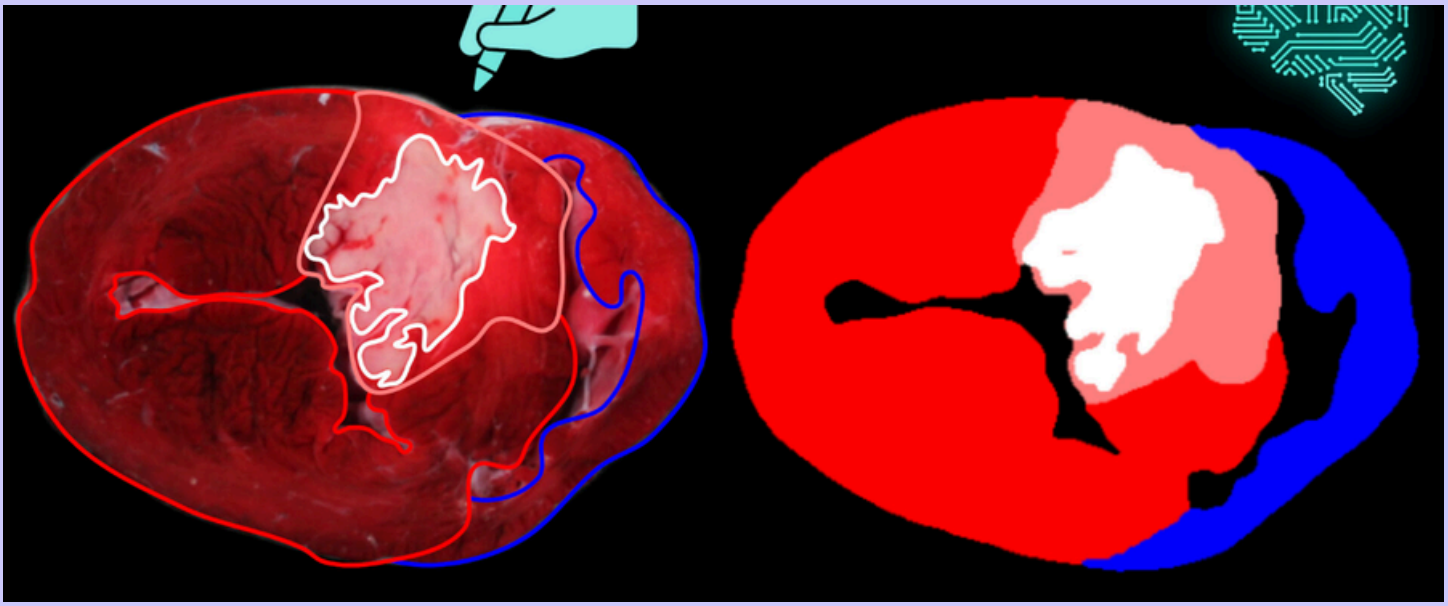
They then placed a fiber-based SCOS source and detector optode in the same region to measure changes in CBF. Of the five participants measured for SCOS, two showed no change in signal intensity (equivalent to single-wavelength fNIRS) with mental deprivation.



Because the same mental subtraction task (with different numbers) was used in the fNIRS measurements, it is possible that these participants had developed different strategies for the math problem and therefore did not show activation in the SCOS measurements.

Kim et al. (2023) used only ROIs with sufficient trial-average responses in ΔOD to calculate trial-average responses in BFi. We found that for all participants with sufficient ΔOD during mental subtraction (Fig. 6c), blood flow significantly increased by 7–16% during activation ($p = 7.7E{-}8$, 0.0083, $2.1E{-}4$ for participants 1, 2, and 3).

Detecting Heart Tissue Damage With 20-Second AI Analysis



In this study, 3,869 digital images of TTC-stained pig heart sections were used to train a deep learning model to determine infarct size. The researchers had previously edited the images by removing distracting backgrounds and adjusting their format.

Initially, several digital images of the heart sections were used to train the artificial intelligence (AI). Infarct areas, unaffected areas, and other important regions were marked by hand in the images. With a specially trained deep learning model based on the U-Net architecture, the evaluation time per experiment could be reduced from 90 minutes to just 20 seconds.

"The results provided by this deep learning computational model in this study were found to be up to 98% consistent with our manual measurements of pig hearts in an independent dataset," said Prof. Petra Kleinbongard, as quoted in a press release.

What is an Infarction? An infarction refers to tissue death due to inadequate blood supply to the affected area. Occured due to arterial blockage, rupture, mechanical compression, or vasoconstriction. The resulting dead tissue is called an infarct. This information is crucial for developing new cardioprotective treatments. To this end, the hearts of pigs that died after a heart attack were removed, cut into slices, and digitally imaged.

A research team from the Medical Faculty of the University of Duisburg-Essen, led by Prof. Petra Kleinbongard and Prof. Gerd Heusch, has now developed a new AI-based method together with Prof. Jakob Nikolas Kather from TU Dresden.

This new method is an objective and reliable alternative to conventional measurements of infarct size and can also be used in research projects. The technology has been successfully tested in various heart models and could significantly advance research into cardioprotective therapies.

AI Analysis for Heart Attack Risk Detection in the Next 10 Years

CT Scan method to detect possible heart attacks

Each year in the UK, around 350,000 people undergo a cardiac CT scan – a standard test to identify narrowing or blockages in the coronary arteries. In around three-quarters of cases, there are no signs of significant narrowing, so patients are often sent home. Unfortunately, many of these people will die of a heart attack in the future, as small, undetected narrowings can rupture if inflamed, blocking the artery. Until recently, it was impossible to identify these at-risk patients.

In a new study, funded by the British Heart Foundation, Professor Charalambos Antoniades and his team at the University of Oxford's Radcliffe Department of Medicine analyzed data from more than 40,000 people undergoing routine cardiac CT scans at eight UK hospitals. Participants were followed for an average of 2.7 years. While those with significant coronary artery narrowing were more likely to experience a serious cardiac event or death, twice as many patients without significant narrowing experienced heart attacks and cardiac death.

The team then used a new AI tool, trained using information about changes in fat around inflamed arteries—which can indicate the risk of events like heart attacks—as well as information about arterial narrowing and other clinical risk factors. Further testing on an additional 3,393 patients over 7.7 years revealed that it could independently and accurately predict the risk of cardiac events. Among those without obstruction in their arteries, those with the highest levels of inflammation in their blood vessels had a more than 10-fold higher risk of cardiac death compared with those with lower levels.

acute multidisiplinary imaging and interventional center - BRC supported cardiovascular research

In the first real-world trial of an AI tool, it was found to improve treatment in up to 45 percent of patients. AI technology has the potential to save the lives of thousands of people with chest pain, who might not otherwise be identified as being at risk of a heart attack and therefore might not receive appropriate treatment to lower their risk. With the technology also found to be cost-effective, researchers hope it could transform the management of patients referred for chest pain investigation across the NHS.

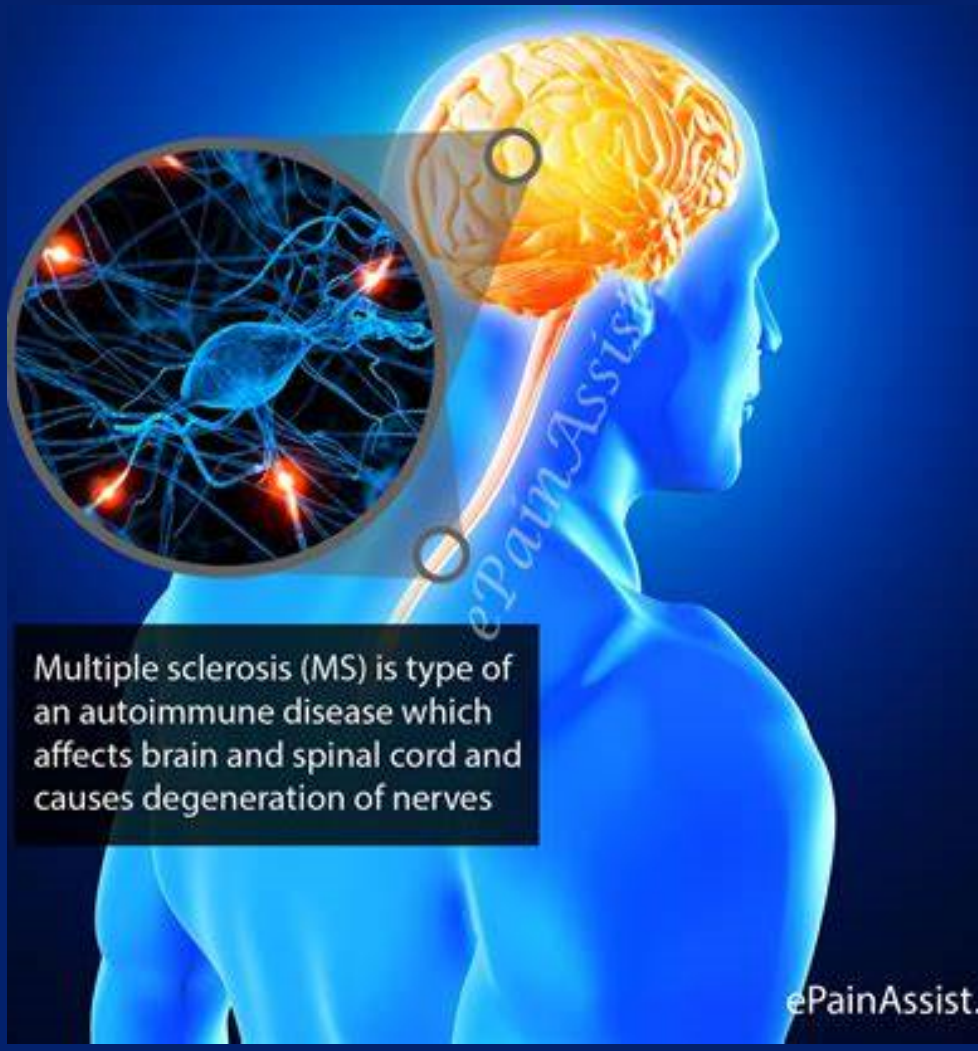
In this world-first trial, the team provided AI-generated risk scores to doctors for 744 consecutive patients and found that in up to 45 percent of cases, doctors changed the patient's treatment plan. This suggests that this AI tool could be invaluable in guiding and informing how patients with chest pain are managed, ensuring early identification and preventative treatment for those at high risk.

An analysis comparing the use of the AI tool with standard care revealed that it was highly cost-effective for the NHS. Furthermore, the researchers estimate that implementing this technology in the NHS could lead to more than 20 percent fewer heart attacks and 8 percent fewer cardiac deaths and strokes among those tested. With the technology needed to power the AI tool already commissioned by NHS England for a pilot program in five NHS hospitals, the researchers hope it can soon be rolled out across the UK.

MORE THAN 1 MILLION PEOPLE

Are Living with Multiple Sclerosis

MULTIPLE SCLEROSIS DAMAGES THE SHEATH OF NERVE CELLS CAUSING SIGNAL TRANSMISSION DISRUPTIVE IN THE FUNCTION OF THE CENTRAL NERVOUS SYSTEM.



Demyealination of Synapse on Central Nervous System

Multiple sclerosis (MS) is an autoimmune disease in which the insulating covering of nerve cells in the brain and spinal cord is damaged. As a demyelinating disease, MS impairs the ability of parts of the nervous system to transmit signals, resulting in a variety of signs and symptoms, including physical, mental, and sometimes psychiatric problems.

Symptoms include double vision, vision loss, eye pain, muscle weakness, and loss of sensation or coordination. Multiple sclerosis has several forms, with new symptoms occurring in isolated attacks (relapsing form) or accumulating over time (progressive form).

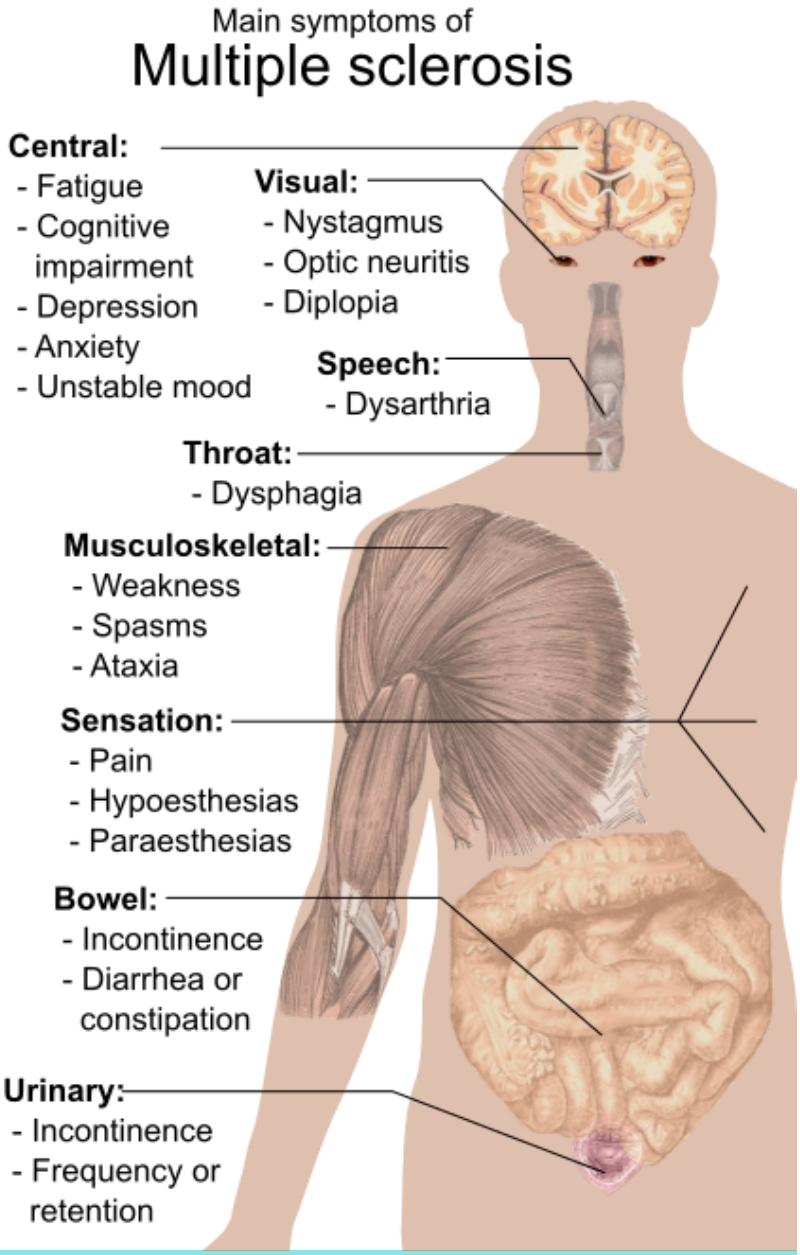
In relapsing forms of MS, symptoms may disappear completely between attacks, although some permanent neurological problems often remain, especially as the disease progresses. In progressive forms of MS, bodily functions slowly deteriorate after symptoms appear and will continue to worsen if left untreated.

SYMPTOMS OF MULTIPLE SCLEROSIS

Various Precursor of The Disease

Because multiple sclerosis (MS) lesions can affect any part of the central nervous system, a person with MS can experience almost any neurological symptom or sign that can be attributed to the central nervous system.

Fatigue is one of the most common symptoms of MS. Approximately 65% of people with MS experience fatigue, and of these, approximately 15-40% report fatigue as their most disabling MS symptom. Autonomic, visual, motor, and sensory problems are also among the most common symptoms.



Specific symptoms are determined by the location of the lesion in the nervous system and may include focal loss of sensation or changes in sensation in the limbs, such as tingling, pins and needles, or numbness; motor weakness/pain in the limbs, blurred vision, pronounced reflexes, muscle spasms, difficulty with ambulation (walking), difficulty with coordination and balance (ataxia); problems with speech or swallowing; visual problems (optic neuritis, which manifests as eye pain and vision loss or nystagmus (double vision)); fatigue; and bladder and bowel problems (such as urinary or fecal incontinence or retention), among others.

As multiple sclerosis progresses, difficulty walking can occur and the risk of falls increases. Difficulty thinking and emotional problems such as depression or mood swings are also common. The primary deficit in cognitive function experienced by people with MS is slowed information processing.

4 TYPES AND STAGES OF MULTIPLE SCLEROSIS

Although the cause is unclear, the underlying mechanism is thought to involve immune system destruction or failure of myelin-producing cells. Proposed causes include immune dysregulation, genetics, and environmental factors, such as viral infections.

The International Advisory Committee on MS Clinical Trials describes four types of MS (revised in 2013) in what is known as the Lublin classification:

1. Clinically Isolated Syndrome (CIS),
2. Relapsing-Remitting MS (RRMS),
3. Primary Progressive MS (PPMS),
4. Secondary Progressive MS (PSMS).

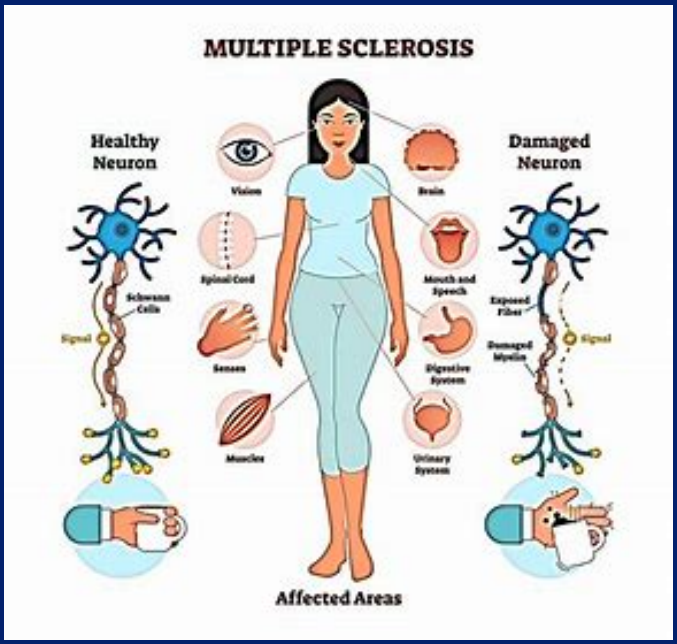
CIS is characterized by a single lesion visible on MRI associated with signs or symptoms found in MS. CIS can be seen as the first episode of demyelination in the central nervous system.

To be classified as CIS, an attack must last at least 24 hours and be caused by inflammation or demyelination of the central nervous system. 30 to 70% of people who experience CIS will later develop Multiple Sclerosis.

RRMS is characterized by unpredictable relapses followed by months to years of relative calm (remission) with no new signs of disease activity.

Deficits that occur during attacks can resolve or persist, the latter in about 40% of attacks and becoming more common the longer a person has the disease.

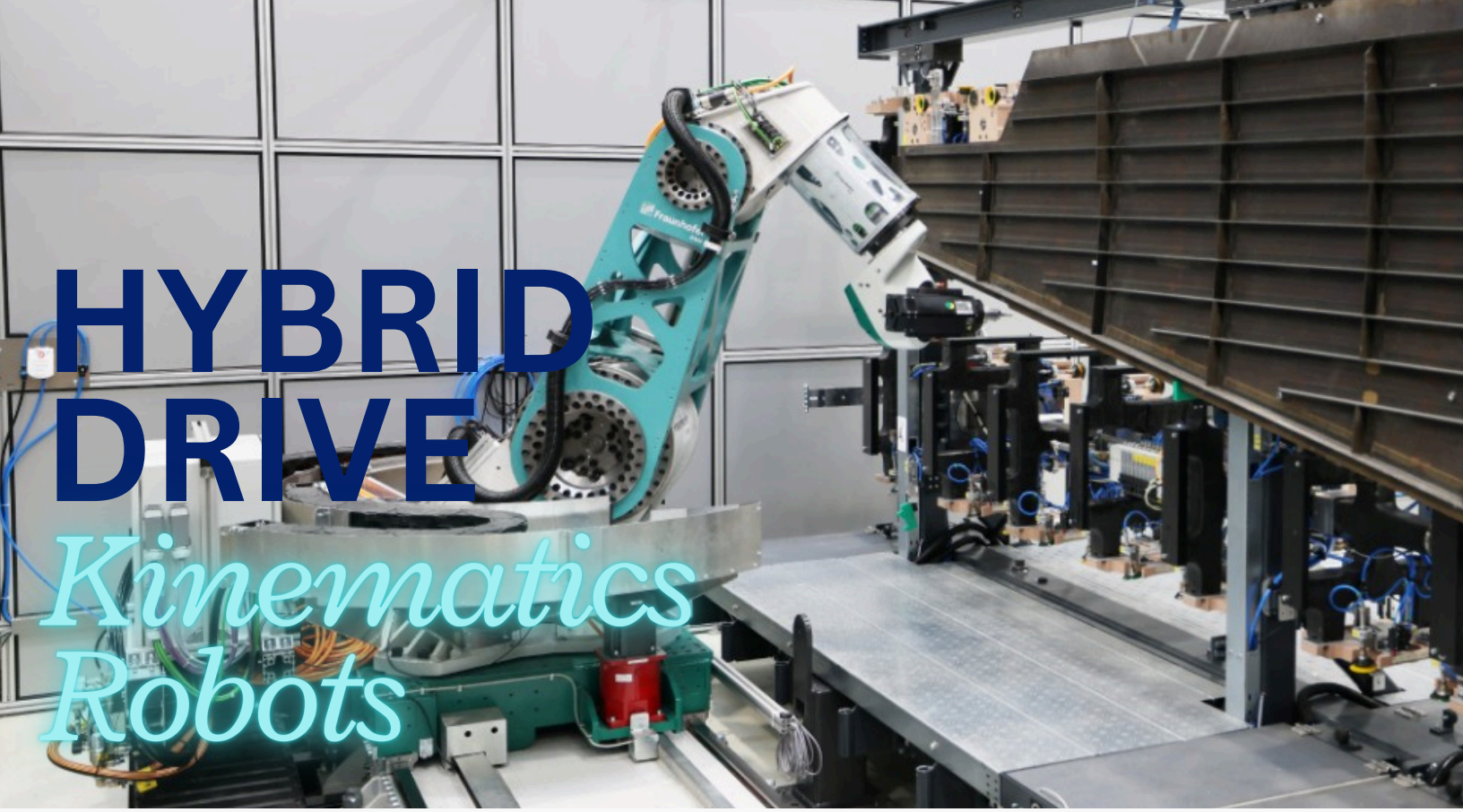
This describes the initial course of 80% of individuals with Multiple Sclerosis. Primary Progressive MS occurs in approximately 10-20% of individuals with the disease, with no remission after initial symptoms.



It is characterized by the development of disability from the onset, with no or only occasional and mild remissions and improvements.

The usual age of onset for the primary progressive subtype is later than the relapsing-remitting subtype. This is similar to the age at which secondary progression typically begins in RRMS, around 40 years.

Secondary Progressive MS occurs in approximately 65% of those with early RRMS, who ultimately experience progressive neurological decline between acute attacks without definite periods of remission. Occasional relapses and mild remissions are common. The most common time between disease onset and conversion from RRMS to SPMS is 19 years.



HYBRID DRIVE

Kinematics Robots

SERIAL FLEXIBLE INDUSTRIAL ROBOTS AND
STATIONARY HIGH-PRECISION MACHINE TOOLS

Serial industrial robots are characterized by their design, which allows flexibility and offers a favorable ratio between required installation space and available workspace. Their use in various manufacturing and production processes has proven efficient and versatile. In handling and assembly technology applications, they are a well-established industrial solution for automating process steps. Other application areas, such as the machining of lightweight materials, are experiencing increasing use of industrial robots.

However, with increasing requirements due to harder materials or more demanding tolerances, industrial robots face limitations due to their limited dynamic properties and higher safety compliance requirements compared to the urgent considerations of machine tool delivery. Due to their kinematic design, machine tools have low safety compliance and high precision, but when scaled up to larger components in the meter range, these machine designs require significant material and investment.

COMBINED LINEAR AXIS ROBOT WITH HYBRID DRIVE

This combination of robotic kinematics with a series of articulated arms with linear axes offers several advantages over large gantry systems and dedicated machining machines.

These include a smaller installation size and a modular linear axis design, making the system highly flexible.

The use of two preloaded rack and pinion drives compensates for the reversal effect and achieves sufficiently high drive stiffness of the linear axis loads for production processes using precision robotics in a series of conveyor lines.

The pinion is a gear mounted on a control shaft and directly connected to the control center.

Due to the high structural stiffness of the linear axes, this results in low robot accuracy, particularly due to the large lever arm at the point of load application.

In the project, a path accuracy of 0.15 millimeters was achieved for large components up to 7 meters long.

Researchers at Fraunhofer IFAM believe that higher accuracy can be achieved by compensating for other static factors, such as temperature, rather than compensating for other dynamic effects.

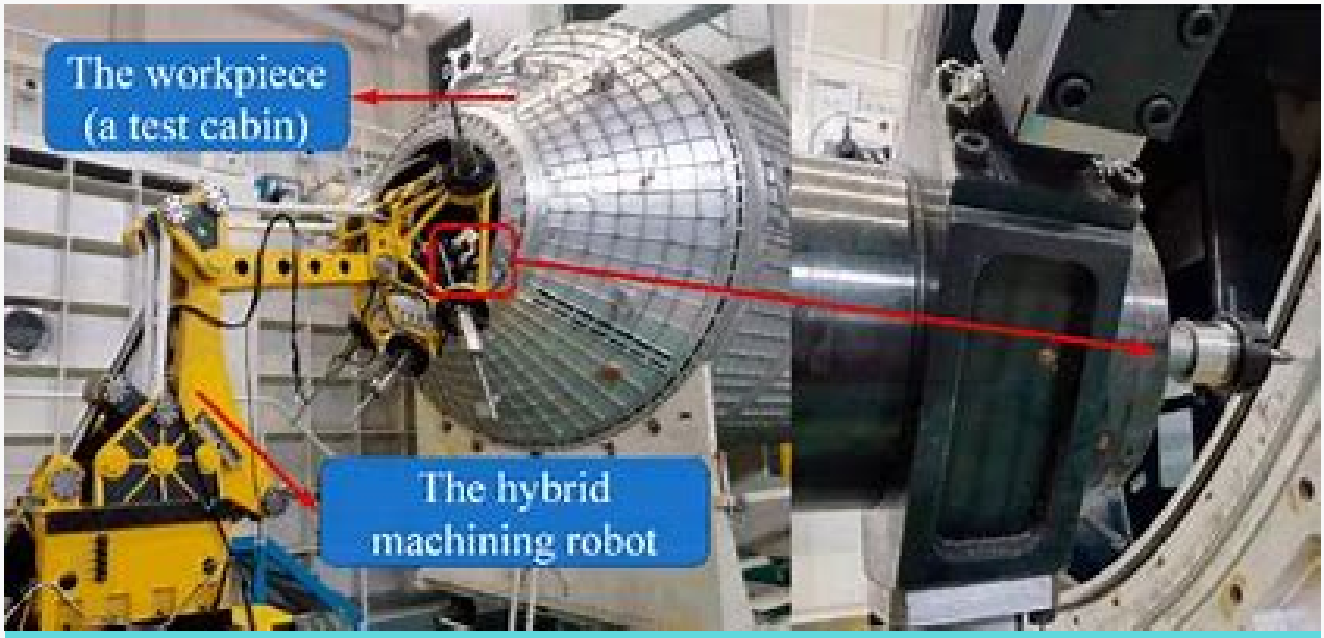
The use of this direct drive (automatic gear) significantly improves the robot's motion detection capabilities according to programming and allows for the reduction and disturbance control of serial robot kinematics at the linear axis level.

The direct mechanical transmission of motor torque to the kinematics also allows for improved jerk control of all lower joint axes.

This system is 10-100 times more precise than conventional servo-driven robots and therefore offers significant potential for increasing productivity.

Furthermore, significant improvements in path accuracy can be demonstrated at high path speeds. At a target speed of 10 meters/minute, path accuracy within the range of previously recorded static accuracies can be demonstrated. The first eigenmode damping system – triggered by gear movement – also has the potential to reduce disturbances.

By machining steel parts, this project successfully took the next step in opening up new application areas for industrial robots. The test parts consisted of various geometries such as angles, surfaces, and circles. They were machined using machining parameters provided by the tool manufacturer.



In aircraft manufacturing, in recent years, the use of new manufacturing processes has led to further developments in the design freedom and structural integrity of net-shaped components made of carbon fiber reinforced plastic (CFRP).

Due to economic and technical requirements, high-precision post-processing of large components in the meter range with tolerances in the sub-millimeter range is typically performed with large gantry-style machine tools.

However, these machines are quite large, depending on their kinematic structure, which often dictates the layout of production facilities and limits their ability to flexibly respond to changes in the production process.

An alternative machine concept is industrial robots, which involve expanding the workspace through mobile platforms, mounting multiple robots, or using additional transformation axes such as linear axes.
Compared to gantry systems or machine tools, this machine concept is much more space-efficient and is not economically tied to individual large components.

Furthermore, it does not require special foundations, facilitating future production line adaptations. In the RoMaNi2 project, a prototype robot was combined with linear axes for path-accurate robots, which were also developed in the Flexmatik 4.1 project.

While industrial robots have been successfully used in the machining of thin aerospace shell components, improving their robustness to process forces and their ability to handle increasingly demanding machining tasks is the next step for the increased use of industrial robots in the production of large aerospace components.

In the RoMaNi 2 project, experts from the Automation and Production Technology department at Fraunhofer IFAM assembled and investigated a serial robot prototype.

The in-house developed kinematics were primarily designed to meet process requirements with high path accuracy.

The goal was to achieve manufacturing tolerances of at least ±0.1 millimeter when machining large components from one component to another. This prototype robot, including the linear axes, was developed as part of the Flexmatik 4.1 project, which culminated in the fabrication of all components.

Assembly of the entire kinematics, commissioning, control optimization, and further development and intensive investigation of the robot's kinematics have now been successfully completed within the RoMaNi 2 project.

Accuracy tests on the prototype robot confirmed that the target of 0.1 millimeter was achieved. Structural optimization is a key element in improving the prototype robot's dynamic behavior.

A key element in improving the dynamic behavior of the prototype robot, in addition to structural optimization, is the use of an innovative drive concept on the lower joint axis.

By using an additional direct drive in parallel with a conventional gear drive, torque can be applied directly to the load side.

This hybrid drive concept combines the ability to compensate for undesirable gearbox effects and dampen high-frequency excitations, while ensuring high energy efficiency in static and quasi-static load conditions. The kinematics are controlled by a Siemens Sinumerik One controller.

This allows widespread expertise in operating CNC machines to be utilized without the need for retraining on a new type of control system.

In the RoMaNi 2 project, the control components for the hybrid drive were further developed, allowing the full potential of the drive to be harnessed in industrial control systems.

20 Years Study of Global Wildfires

From Day to Night

Recently, more than 70 forest fires has had burned simultaneously in Greece.

In early 2024, Chile experienced its worst forest fire season in history, with more than 130 people killed.

Last year, record-breaking Canadian wildfires burned from March to November, and in August, fires devastated the Hawaiian island of Maui.

Researchers identified a total of 30 million fires (technically 30 million "fire events," which can include multiple fire clusters grouped together).

They then selected the top 2,913 with the most energy released, representing 0.01% of the "most extreme" wildfires.

Their work shows that these extreme wildfires are becoming more frequent, with their number doubling over the past two decades.

Since 2017, Earth has experienced six years with the highest number of extreme wildfires (all years except 2022).

Recent Research

Researchers at the University of Tasmania, for the first time, calculated the energy released by different fires over a 21-year period from 2003 to 2023.

They did this using satellite-based sensors that can identify heat from fires, measuring the energy released as "fire radiant power."

extreme wildfires are also becoming even more intense

Watching the news, it certainly feels like extreme wildfire disasters are happening more frequently.

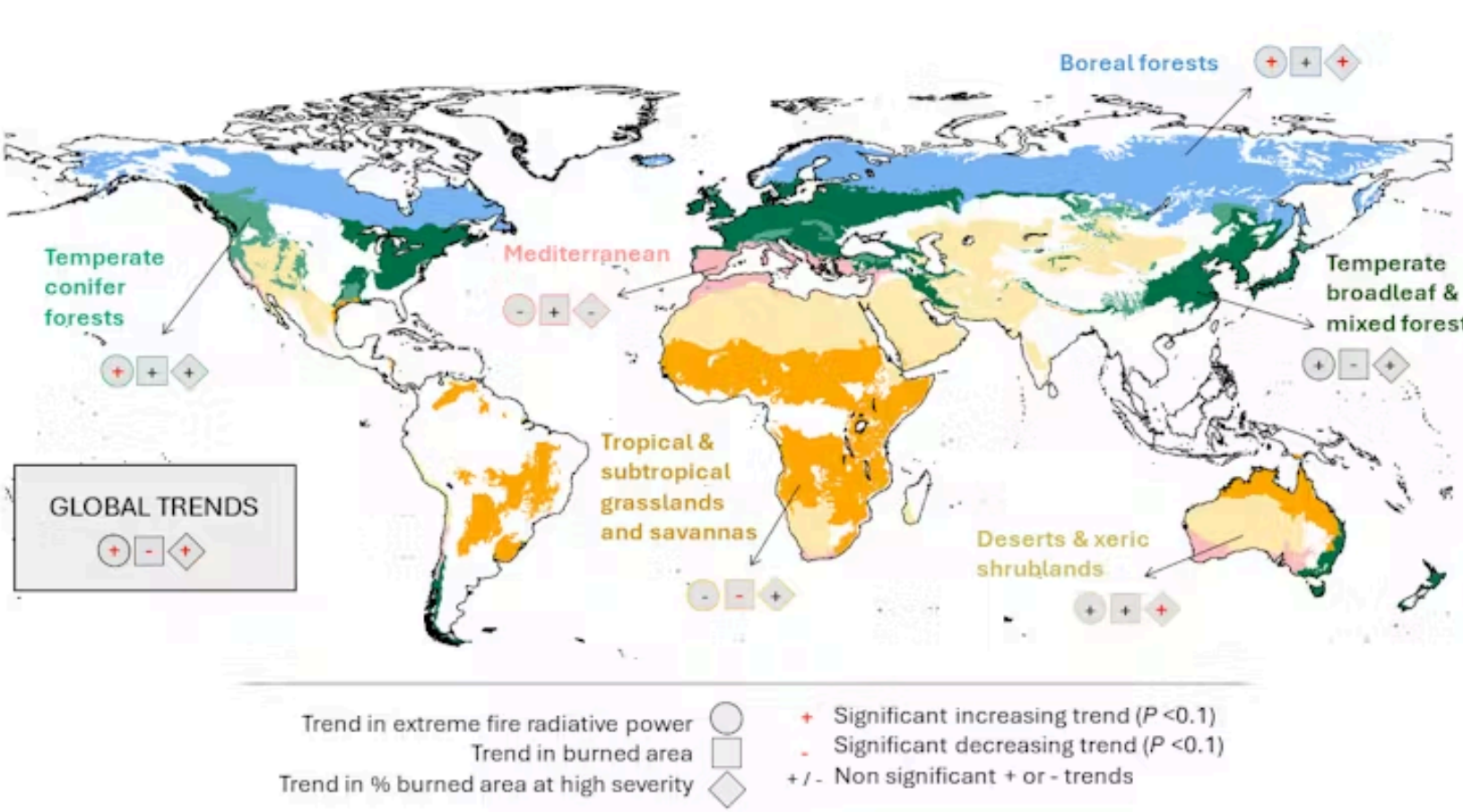
A new study published in Nature Ecology & Evolution shows that the number and intensity of Earth's most extreme wildfires have doubled over the past two decades.

Wildfires classified as extreme in recent years released twice as much energy as those classified as extreme at the beginning of the study period.

This finding aligns with other recent evidence that wildfires are worsening. For example, the area of forest burned each year has slightly increased, leading to a corresponding increase in forest carbon emissions.

The total area burned each year has actually decreased due to a decrease in grassland and agricultural fires, but these fires are of lower intensity and emit less carbon than wildfires.

Burn severity – an indicator of how much damage a fire has caused to an ecosystem – has also worsened in many regions, and the percentage of burned land affected by high-severity burning has also increased globally.



While the overall global outlook is not good, there are striking differences between regions. A new study identifies boreal forests in the far north and temperate coniferous forests (blue and light green in the map above) as critical ecosystem types driving the global increase in extreme wildfires.

They have a higher number of extreme fires relative to their area and show the most dramatic worsening over time, while also seeing increases in total area burned and the percentage burned at high severity. The confluence of these three trends is particularly pronounced in eastern Siberia and the western US and Canada.

NEW EVIDENCE UNDERSCORES THE URGENCY OF ADDRESSING THE ROOT CAUSES BEHIND WORSENING WILDFIRE ACTIVITY, SUCH AS LAND COVER CHANGES, FOREST POLICIES AND MANAGEMENT, AND, OF COURSE, CLIMATE CHANGE.

Many locations are also vulnerable to fires that are becoming more consequential, as what turns a fire into a disaster depends not only on fire trends but also on the environmental, social, and economic context.

For example, in temperate broadleaf forests around the Mediterranean, there have been no major changes in fire activity and behavior. However, the increasing number of houses built within and around wild vegetation in fire-prone areas is a clear example of actions that increase human risk and can lead to disaster.

The multiplication of extreme wildfires adds to the complex picture of fire patterns and trends. This new evidence underscores the urgency of addressing the root causes behind worsening wildfire activity, such as land cover change, forest policy and management, and, of course, climate change. This will better prepare us for these extreme fires, which are nearly impossible to combat using traditional firefighting methods.

WHAT TURNS A FIRE INTO A CATASTROPHE

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