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समाचार पत्रों से चयनित अंश
Newspapers Clippings

डीआरडीओ समुदाय को डीआरडीओ प्रौद्योगिकियों, रक्षा प्रौद्योगिकियों, रक्षा नीतियों, अंतर्राष्ट्रीय संबंधों और विज्ञान एवं प्रौद्योगिकी की नूतन जानकारी से अवगत कराने हेतु दैनिक सेवा

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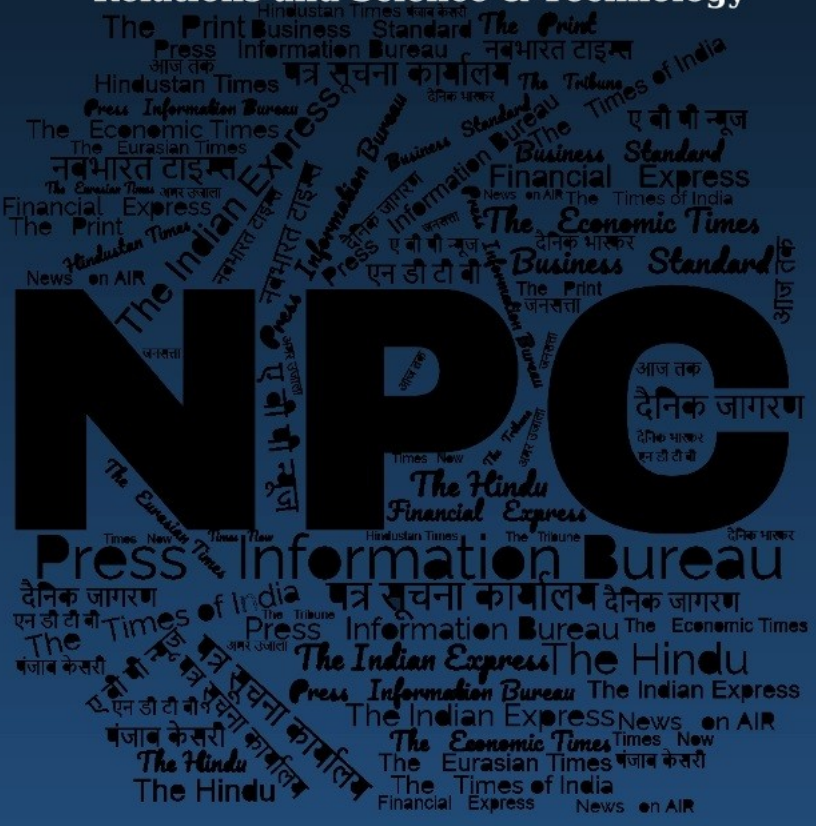

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Defence News

Defence Strategic: National/International

Inter-Governmental Agreement inked with France for 26 Rafale-Marine aircraft for Indian Navy

Source: Press Information Bureau, Dt. 28 April 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2124851

The Governments of India and France have signed an Inter-Governmental Agreement (IGA) for the procurement of 26 Rafale Aircraft (22 Single-Seater and four Twin-Seater) for the Indian Navy. It includes Training, Simulator, Associated Equipment, Weapons and Performance-Based Logistics. It also includes additional equipment for the existing Rafale fleet of the Indian Air Force (IAF).

The IGA has been signed by Raksha Mantri Shri Rajnath Singh and Minister of Armed Forces of France Mr Sebastien Lecornu. The signed copies of the agreement, aircraft package supply protocol and weapons package supply protocol were exchanged by Indian and French officials in the presence of Defence Secretary Shri Rajesh Kumar Singh at Nausena Bhawan, New Delhi on April 28, 2025.

In line with the Government's thrust on Aatmanirbhar Bharat, the agreement includes Transfer of Technology for integration of indigenous weapons in India. It also includes setting up of production facility for Rafale Fuselage as well as Maintenance, Repair and Overhaul facilities for aircraft engine, sensors and weapons in India. The deal is expected to generate thousands of jobs and revenue for a large number of MSMEs in setting up, production and running of these facilities.

Manufactured by France's Dassault Aviation, the Rafale-Marine is a carrier-borne combat-ready aircraft with proven operational capabilities in maritime environment. The delivery of these aircraft would be completed by 2030, with the crew undergoing training in France and India.

Rafale-Marine has commonality with the Rafale being operated by IAF. Its procurement will substantially enhance joint operational capability, besides optimising training and logistics for the aircraft for both Indian Navy and IAF. The induction would lead to the addition of a potent force multiplier to the Indian Navy's aircraft carriers, substantially boosting the nation's air power at sea.

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Rafale-M vs Rafale: IAF का राफेल और नेवी का राफेल-एम... ताकत, डिजाइन और मिशन में कौन कितना अलग?

Source: Aaj Tak, Dt. 28 April 2025,
URL: https://www.aajtak.in/defence-news/story/difference-between-rafale-and-rafale-marine-fighter-jet-know-the-specifications-dskc-2227561-2025-04-28

राफेल मरीन और वायुसेना के राफेल में मुख्य अंतर उनके संचालन के माहौल और मिशन प्रोफाइल में है. राफेल–एम को विमानवाहक पोतों पर समुद्री युद्ध के लिए विशेष रूप से डिज़ाइन किया गया है. जबकि वायुसेना का राफेल जमीन से संचालित होकर हवाई और सामरिक मिशनों पर केंद्रित है. ये अंतर राफेल मरीन को भारतीय नौसेना की समुद्री रणनीति के लिए एक अनिवार्य संपत्ति बनाते हैं, जो हिंद महासागर में भारत की ताकत को और मजबूत करेगा.

लैंडिंग गियर और एयरफ्रेम

राफेल मरीन: विमानवाहक पोतों (जैसे INS विक्रांत और INS विक्रमादित्य) के सीमित डेक पर टेकऑफ और लैंडिंग के लिए राफेल–एम में मजबूत और विशेष रूप से डिज़ाइन किया गया लैंडिंग गियर है. इसका एयरफ्रेम भी समुद्री परिस्थितियों जैसे नमक और नमी का सामना करने के लिए संशोधित है.

वायुसेना राफेल: वायुसेना के राफेल में सामान्य रनवे संचालन के लिए हल्का लैंडिंग गियर और एयरफ्रेम है, जो समुद्री संचालन के लिए सही नहीं है.

फोल्डिंग विंग्स

राफेल मरीन: विमानवाहक पोतों पर सीमित जगह को ध्यान में रखते हुए, राफेल–एम के पंख फोल्ड होने की सुविधा के साथ आते हैं। इससे जेट्स को डेक पर आसानी से स्टोर किया जा सकता है.

राफेल: वायुसेना के राफेल में फोल्डिंग विंग्स की सुविधा नहीं है, क्योंकि यह हवाई अड्डों पर संचालित होता है, जहां जगह की कमी नहीं होती.

वजन

राफेल मरीन: राफेल–एम का वजन वायुसेना के राफेल से थोड़ा अधिक है, क्योंकि इसमें समुद्री संचालन के लिए अतिरिक्त संशोधन जैसे मजबूत लैंडिंग गियर और संक्षारण–प्रतिरोधी कोटिंग शामिल हैं.

राफेल: यह हल्का होता है, क्योंकि इसे समुद्री संचालन की विशिष्ट आवश्यकताओं के लिए डिज़ाइन नहीं किया गया है.

शॉर्ट टेकऑफ और लैंडिंग (STOL)

राफेल मरीन: राफेल–एम में शॉर्ट टेकऑफ और लैंडिंग की क्षमता को बढ़ाया गया है, ताकि यह विमानवाहक पोतों के छोटे डेक पर आसानी से संचालित हो सके. इसमें कैटापल्ट–असिस्टेड टेकऑफ और अरेस्टर हुक सिस्टम भी शामिल हैं.

राफेल: यह सामान्य रनवे पर संचालन के लिए डिज़ाइन किया गया है, इसलिए इसमें कैटापल्ट या अरेस्टर हुक जैसे सिस्टम नहीं हैं.

मिशन प्रोफाइल

राफेल मरीन: इसे विशेष रूप से समुद्री युद्ध के लिए अनुकूलित किया गया है. यह जहाज–रोधी युद्ध (Anti–Ship Warfare), समुद्री निगरानी और समुद्र में लंबी दूरी के हमलों के लिए डिज़ाइन किया गया है. इसमें एक्सोसेट जैसी जहाज–रोधी मिसाइलों का उपयोग शामिल है.

राफेल: यह मुख्य रूप से हवा से हवा और हवा से जमीन मिशनों के लिए डिज़ाइन किया गया है, जैसे दुश्मन के ठिकानों पर हमला, हवाई रक्षा और सामरिक बमबारी.

जंग लगने से बचाव

राफेल मरीन: समुद्री वातावरण में नमक और नमी के कारण होने वाले संक्षारण से बचाने के लिए राफेल–एम में विशेष कोटिंग और सामग्री का उपयोग किया गया है.

राफेल: इसमें ऐसी विशेष कोटिंग की आवश्यकता नहीं है, क्योंकि यह मुख्य रूप से जमीन पर आधारित हवाई अड्डों से संचालित होता है.

हथियार और सेंसर कॉन्फिगरेशन

राफेल मरीन: इसमें समुद्री मिशनों के लिए विशेष हथियार, जैसे एक्सोसेट मिसाइल और समुद्री निगरानी के लिए सेंसर शामिल हैं.

राफेल: यह मेटियोर, स्कैल्प और अन्य हवा से हवा या हवा से जमीन मिसाइलों के लिए कॉन्फिगर किया गया है, जो सामान्य युद्ध परिदृश्यों के लिए उपयुक्त हैं.

रखरखाव और लॉजिस्टिक्स

राफेल मरीन: चूंकि भारतीय वायुसेना पहले से ही राफेल का संचालन कर रही है, राफेल–एम के लिए लॉजिस्टिक्स और रखरखाव में कुछ समानता होगी. हालांकि, समुद्री संचालन के लिए अतिरिक्त प्रशिक्षण और सुविधाओं की आवश्यकता होगी.

राफेल: इसका रखरखाव स्थापित हवाई अड्डों पर पहले से मौजूद बुनियादी ढांचे के आधार पर किया जाता है.

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Rajnath Singh meets PM Modi, discusses security situation as Pakistan firing continues

Source: The Economic Times, Dt. 29 April 2025,
URL: https://economictimes.indiatimes.com/news/defence/rajnath-singh-meets-pm-modi-discusses-security-situation-as-pakistan-firing-continues/articleshow/120705806.cms

Defence minister Rajnath Singh met Prime Minister Narendra Modi on Monday to discuss the security situation, even as firing by Pakistani forces on the Line of Control (LoC) continued for the fourth successive day.

Sources said the minister held a 40-minute meeting with the PM on the prevailing security situation. The preparedness of the armed forces is likely to have been on the agenda. The minister has earlier held meetings with the top military leadership as military options are being weighed to target the perpetrators and backers of the terrorists who targeted civilians, mostly tourists, in Pahalgam.

The situation on the LoC remains fragile as reports of small arms firing by Pakistani Army posts continue. Officials said the firing is being responded to and has not yet scaled up to heavy firing involving artillery or mortars. The continued firing by Pakistani troops has shattered the ceasefire arrangement that has been standing since 2021. India has also been flexing its muscles with a range of live firing drills and exercises over the past few days.

This includes battlefield drills by mechanised forces in Rajasthan and training missions for special heliborne operations in Punjab. The Navy has carried out multiple live firings in the Arabian sea involving long-range anti-ship missiles. The 'validation drills' included live tests for its medium range anti-air missile systems.

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Cold Start: India's answer to Pakistan's nuclear threats

Source: The Economic Times, Dt. 28 April 2025,
URL: https://economictimes.indiatimes.com/news/defence/cold-start-indias-answer-to-pakistans-nuclear-threats/articleshow/120701537.cms

The Pahalgam terror attack has once again brought India and Pakistan to the brink of armed conflict if not war. India had earlier launched surgical strikes on terror launchpads within Pakistan in 2016 and 2019, both in response to terror attacks in J&K by Pakistan-sponsored terrorists. This time, India's response could be more than just a surgical strike. Prime Minister Narendra Modi has said that the terrorists as well as their backers will be punished beyond their imagination. Pakistan's defence minister Khawaja Asif has told Retuers today that a military incursion by India was "imminent".

Both India and Pakistan being nuclear powers, any possibility of conflict raises worries about the conflict getting out of control. However, it's Pakistan which has been able to take more benefit of nuclear deterrence mainly due to India's responsible no-first-use policy. However, India has a

strategy to counter Pakistan's nuclear blackmailing. It's called the Cold Start doctrine. It is aimed at punishing Pakistan but keeping the conflict below the nuclear threshold.

What is the Cold Start doctrine?

The name 'Cold Start' suggests the wish to avoid a full-scale 'hot' war. It means Indian forces making swift and hard inroads into Pakistan. Such strikes will be limited in scope so as not to give any reason to Pakistan to launch a full-scale retaliation. Surprise is a key element of the Cold Start doctrine. In traditional offense, the mobilisation of troops takes a lot of time. By then, the enemy country can not only prepare for a response but also activate international diplomatic channels to prevent Indian attack.

Why Cold Start?

The need for the Cold Start doctrine emerged out of the fact that Pakistan being a nuclear country, the war will ultimately be mutually destructive. Pakistan has used its nuclear-power status to counter India's warnings of armed conflict. Pakistan has indicated often that it would not shy away from using nuclear weapons against India. A Cold Start gives India an escape from the inevitability of nuclear conflict with Pakistan. A Cold Start allows India to attack Pakistan without the possibility of a full-scale war breaking out since Cold Start strikes are limited in scope and never raise enough temperature to give Pakistan a reason to mobilise its forces for a full war.

How did the Cold Start doctrine emerge?

The idea for the Cold Start was fuelled by Operation Parakram, launched after the terror attack on Parliament in December 2001. The operation exposed major operational gaps in India's offensive power, mainly slow troop mobilisation along the border. After the attack, Indian strike corps took almost a month to reach the border. This gave Pakistan enough time to take countermeasures, and for the US to pressurize the then-NDA government to back off. In 2009, then Army chief Gen Deepak Kapoor said that "a major leap in our approach to conduct of operations has been the successful firming-in of the 'Cold Start' strategy." Later, Gen General Bipin Rawat publicly acknowledged the existence of such a doctrine when he became the army chief.

What is Pakistan's counter to India's Cold Start doctrine?

Pakistan and critics of the Cold Start doctrine think that India's success in a Cold Start depends on various factors such as terrain, the element of surprise and how Pakistan deploys its forces. But the biggest challenge for a Cold Start is Pakistan's counter-strategy to use tactical nuclear weapons (TNWs). In 2019, then Pakistani railway minister Sheikh Rashid Ahmed claimed that his country possessed "125-250 gram atom bombs".

"Pakistan has small 125-250 gram atom bombs which may hit a targeted area in India," Rashid was quoted as saying by Geo News. What the minister said is part of Pakistan's Full Spectrum Deterrence policy, a counter strategy to India's Cold Start doctrine, which include the use of TNWs against Indian soldiers for battlefield victory instead of hitting cities with bigger nuclear weapons.

In 2017, then Pakistan Prime Minister Shahid Khaqan Abbasi too said that his country had developed short-range nuclear weapons to counter the 'Cold Start' doctrine adopted by the Indian Army.

From the war in Ukraine to North Korea's missile testing spree, tactical nuclear weapons are being debated and developed in a way not seen since the Cold War. Tactical nuclear weapons are often characterized by their size, their range, or their use for limited military targets. They are often referred to as "non-strategic weapons", in contrast with strategic weapons, which the US military defines as designed to target "the enemy's warmaking capacity and will to make war," including manufacturing, infrastructure, transportation and communication systems, and other targets. Tactical weapons, by contrast, are designed to accomplish more limited and immediate military goals that win a battle.

The term is often used to describe weapons with a lower "yield", or the amount of power released during an explosion. They are typically many times larger than conventional bombs, cause radioactive fallout and other deadly effects beyond the explosion itself, and there is no agreed upon size that defines tactical weapons. Tactical weapons are often mounted on as missiles, air-dropped bombs, or even artillery shells that have a relatively short range, far less than the huge intercontinental ballistic missiles (ICBMs) designed to travel thousands of kilometres and strike targets across oceans. However, many of these delivery systems can also deliver strategic nuclear weapons.

Pakistan's tactical nuclear weapons primarily consist of short-range ballistic missiles like the Hatf and Nasr, along with a few medium-range missiles. These missiles are designed for shorter-range, battlefield use, and some are road-mobile.

Can Pakistan use its Tactical Nuclear Weapons against?

Though the concept of TNWs seems very convincing, they may not be as useful, safe, effective or easy to operate as it may sound. "Pakistan's TNWs might deter India's conventional military superiority from translating into territorial gains," an article in Observer Research Foundation argues. "The mere threat of nuclear escalation, even at a tactical level, could compel India to maintain a measured response in a potential conflict. However, the actual use of TNWs carries immense risks of uncontrollable escalation and catastrophic humanitarian consequences. Therefore, Pakistan's TNW programme likely functions as a deterrent through credible signalling, not a tool for actual battlefield use."

As per late Gurmeet Kanwal, one of India's most eminent scholars of military strategy, short-range missiles like the Nasr armed with TNWs are inherently destabilising and there are several compelling reasons for leaving these out of the nuclear arsenal.

"Firstly, these are extremely complex weapons (particularly sub-kiloton mini-nukes, because of the precision required in engineering) and are difficult and expensive to manufacture and support technically," he had written in an article in the MP-IDSA journal. "Inducting them into service even in small numbers is a drag on the budget of the strategic forces. Secondly, the command and control of TNWs needs to be decentralised at some point during war to enable their timely employment. Extremely tight control would make their possession redundant and degrade their deterrence value. Decentralised control would run the risk of their premature and even unauthorised use – Kissinger's "mad major syndrome". Thirdly, since the launchers must move frequently to avoid being targeted, dispersed storage and frequent transportation of TNWs under field conditions, increases the risk of accidents. Lastly, the employment of conventional artillery

and air-to-ground precision weapons by the enemy may damage or destroy forward stored nuclear warheads."

"Even though Pakistan has chosen to acquire these dangerous weapons, India has wisely opted not to go down the TNW route," Kanwal wrote further. "The Nasr missile is said to be Pakistan's answer to India's Cold Start doctrine. The Pakistan army proposes to use the Nasr missile to drop a low-yield nuclear warhead on Indian mechanised forces that have entered Pakistani territory with a view to stopping the Indian offensive in its tracks. It is a patently flawed approach as, in response to a nuclear attack on its forces, India will execute its doctrine of massive retaliation and Pakistan will cease to exist as a functional nation state.Surely, that is not the end state that the Pakistan army is prepared to accept. Hence, Pakistan's TNWs are a bluff that India can call."

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IAF to get new Vice Chief, tri-services to get new CISC, Army getting new Northern Army commander

Source: The Economic Times, Dt. 28 April 2025,
URL: https://economictimes.indiatimes.com/news/defence/iaf-to-get-new-vice-chief-tri-services-to-get-new-cisc-army-getting-new-northern-army-commander/articleshow/120704577.cms

The Indian Air Force will get a new Vice Chief as Air Marshal Narmadeshwar Tiwari would be succeeding incumbent Air Marshal SP Dharkar on May 1.

Dharkar is superannuating on April 30 after an illustrious career of 40-plus years in the force.

Air Marshal Tiwari is presently commanding the South Western Air Command in Gandhinagar.

He would be succeeded by the present Training Command chief. The tri-services integrated Defence Staff will get a new Chief of Integrated Defence Staff to the Chairman Chiefs of Staff Committee (CISC)

Air Marshal Ashutosh Dixit has been approved to take over as the new CISC in place of Lt Gen JP Matthew, who is superannuating on April 30.

The CISC is responsible for coordination among the three services and is part of the Chief of Defence Staff team in managing the tri-services affairs.

Air Marshal Dixit is a Mirage 2000 fighter jet pilot and is presently heading the all-important Central Air Command in Prayagraj. He will be assuming his new office on May 1.

Meanwhile, the Northern Command of the Indian Army, responsible for operations along the China and Pakistan border in Jammu and Kashmir and Ladakh sectors, will get a new chief in Lt Gen Prateek Sharma.

Lt Gen Sharma is presently the Deputy Chief of Army Staff (Strategy) in the Army Headquarters and has also served as Director General Military Operations.

The officer would be replacing the incumbent Lt Gen MV Suchendra Kumar who is superannuating on April 30.

Lt Gen Sharma had recently travelled with Army Chief Gen Upendra Dwivedi on Friday to Srinagar post Pahalgam attack.

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India's military might bolstered since Balakot airstrikes in 2019

Source: Hindustan Times, Dt. 29 April 2025,
URL: https://www.hindustantimes.com/india-news/indias-military-might-bolstered-since-balakot-airstrikes-in-2019-101745866501159.html

India has significantly multiplied its offensive capabilities since the 2019 Balakot airstrikes in Pakistan, and during the border standoff with China, and the new weapons and systems it has modernised its arsenal with bring more options on the table as New Delhi carefully weighs military action to punish Pakistan for being behind the Pahalgam terror attack, officials aware of the matter said on Monday.

With Prime Minister Narendra Modi and his top ministers pledging a crushing response, India has strengthened its military posture across the western front after the April 22 attack that killed 26 people, including the volatile Line of Control (LoC) which is witnessing a sharp escalation of hostilities following constant ceasefire violations by the Pakistan Army.

"Many capability gaps have been fixed during the last five to six years through imports and locally produced weaponry. The new capabilities can pack a mean punch. Overall, the military is far more potent than what it was when the Balakot airstrikes were executed," said one of the officials cited above, asking not to be named.

The military hardware inducted to power the war machine includes Rafale fighter jets, S-400 air defence missile systems, Barak 8 air defence system, the indigenous aircraft carrier INS Vikrant, a raft of warships and submarines including the nuclear-powered ballistic missile submarine INS Arighaat, the Prachand light combat helicopters, the C-295 tactical transport aircraft, artillery guns and a new range of assault rifles.

The capability boost, which coincided with the military standoff with China in eastern Ladakh, covers a variety of unmanned systems, smart air-to-ground weapons, missiles, rockets, precision munitions, tank ammunition, high-tech surveillance systems and specialist vehicles.

Sustained capability development in recent years has addressed shortfalls and boosted the military's preparedness to carry out the missions assigned to it in a fluid security environment such as the one being witnessed now, said another official.

"When the orders come, the armed forces will deliver," he added, asking not to be named.

On Sunday, Prime Minister Narendra Modi said the perpetrators and conspirators of the Pahalgam attack will be served the harshest response, seen by many as a stern warning to Pakistan. "The

unity of the country, the solidarity of 140 crore Indians is our biggest strength in the war against terror," he said.

His comments came on a day multiple Indian warships showcased their long-range precision strike capabilities during drills in the Arabian Sea.

The new inductions, especially the Rafale- S 400 combination, have given India a direct edge over the adversary, said strategic affairs expert Air Marshal Anil Chopra (retd). "The weapons and systems in our arsenal are a nightmare for Pakistan. We have not only boosted our military capability but are also on track to induct newer weapons and technologies with an eye on the future."

India is developing a range of new weapons and technologies that have propelled it into a select league of countries.

The recent unveiling of a locally produced laser weapon that can knock out drones has put the spotlight on cutting-edge defence technologies that India has demonstrated during the last two to three years, with the developments boosting the country's global stature and paving the way for the armed forces to deploy a new range of weapons.

Only a few countries possess some of the technologies that India has showcased.

The April 13 successful trial of the directed energy weapon (DEW) system with a 30-kilowatt laser came months after India for the first time carried out a ground test of a scramjet engine, an air breathing engine capable of sustaining combustion during supersonic flights. The development is being seen as a crucial milestone in developing next-generation hypersonic missiles that can travel at speeds of more than Mach 5 or five times the speed of sound.

The few countries that have mastered the technology to disable missiles, drones and smaller projectiles using a laser weapon include the US, Russia, China, the UK, Germany and Israel. Similarly, only the US, Russia and China have developed technologies to field fast-manoeuvring hypersonic missiles that fly at lower altitudes and are extremely hard to track and intercept.

Other recent notable achievements by India include the launch of the 3,500-km range K-4 nuclear capable ballistic missile from a submarine, the testing of the second phase of India's ballistic missile defence system and developing the Agni-5 missile with multiple independently targetable re-entry vehicle (MIRV) technology. The MIRV capability allows the weapon system to deliver multiple nuclear warheads against different targets spread across hundreds of kilometres. MIRVs can cause more destruction than traditional missiles that carry a single warhead.

Last November, INS Arighaat launched the K-4 missile for the first time, a step towards strengthening the country's nuclear triad (ability to launch strategic weapons from land, sea and air). India also tested its first long-range hypersonic missile, a weapon designed to deliver various payloads at ranges greater than 1,500 km.

India is also developing a long-range surface-to-air missile system under the DRDO's Project Kusha. It will have a range of 350 km and is expected to be deployed in four to five years.

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Global military spending soars to $2.7 trillion in 2024; Russia, US, China, India, Germany account for 60%

Source: The Economic Times, Dt. 28 April 2025,
URL: https://economictimes.indiatimes.com/news/defence/global-military-spending-soars-to-2-7-trillion-in-2024-russia-us-china-india-germany-account-for-60/articleshow/120689529.cms

Amid the major global conflicts, including the Russia-Ukraine war, and the Israel-Palestine conflict, world military expenditure reached USD 2718 billion in 2024, an increase of 9.4 per cent in real terms from 2023 and the steepest year-on-year rise since at least the end of the cold war, according to new data by the Stockholm International Peace Research Institute (SIPRI).

Military spending increased in all world regions, with particularly rapid growth in both Europe and the Middle East. The top five military spenders--the United States, China, Russia, Germany and India--accounted for 60 per cent of the global total, with combined spending of USD 1635 billion.

SIPRI, an independent international institute dedicated to research into conflict, armaments, arms control and disarmament, in its report on Monday, stated that military spending in Europe (including Russia) rose by 17 per cent to USD 693 billion and was the main contributor to the global increase in 2024. All European countries increased their military spending in 2024 except Malta.

Russia's military expenditure reached an estimated USD 149 billion in 2024, a 38 per cent increase from 2023 and double the level in 2015. This represented 7.1 per cent of Russia's GDP and 19 per cent of all Russian government spending. Ukraine's total military expenditure grew by 2.9 per cent to reach USD 64.7 billion, equivalent to 43 per cent of Russia's spending. At 34 per cent of GDP, Ukraine had the largest military burden of any country in 2024.

Several countries in Central and Western Europe saw unprecedented rises in their military expenditure in 2024 as they implemented new spending pledges and large-scale procurement plans. Germany's military expenditure increased by 28 per cent to reach USD 88.5 billion, making it the biggest spender in Central and Western Europe and the fourth biggest in the world. Poland's military spending grew by 31 per cent to USD 38.0 billion in 2024, representing 4.2 per cent of Poland's GDP, SIPRI noted.

All NATO members also raised their military expenditure in 2024. Total military spending by NATO members amounted to USD 1506 billion, or 55 per cent of global military expenditure. Of the 32 NATO members, 18 spent at least 2.0 per cent of GDP on their militaries, up from 11 in 2023 and the highest number since NATO adopted the spending guideline in 2014.

Military spending by the US rose by 5.7 per cent to reach USD 997 billion, which was 66 per cent of total NATO spending and 37 per cent of world military spending in 2024. Military expenditure in the Middle East reached an estimated USD 243 billion in 2024, an increase of 15 per cent from 2023 and 19 per cent more than in 2015.

Israel's military expenditure surged by 65 per cent to USD 46.5 billion in 2024, the steepest annual increase since the Six-Day War in 1967. Its military burden rose to 8.8 per cent of GDP, the second highest in the world. Lebanon's military spending rose by 58 per cent in 2024 to USD 635 million, after several years of lower spending due to economic crisis and political turmoil. However, Iran's military spending fell by 10 per cent in real terms to USD 7.9 billion in 2024 despite its involvement in regional conflicts and its support for regional proxies, SIPRI reported.

Meanwhile, China, the world's second-largest military spender, increased its military expenditure by 7 per cent to an estimated USD 314 billion, marking three decades of consecutive growth. China accounted for 50 per cent of all military spending in Asia and Oceania, investing in the continued modernisation of its military and expansion of its cyberwarfare capabilities and nuclear arsenal.

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LAC disengagement later, geotagging of patrolling points, more surveillance, patrols

Source: The Indian Express, Dt. 29 April 2025,
URL: https://indianexpress.com/article/india/lac-disengagement-later-geotagging-of-patrolling-points-more-surveillance-patrols-9971423/

India is in the process of geotagging established patrolling points and other landmarks on the Line of Actual Control (LAC) in eastern Ladakh to aid easier identification and demarcation of its boundary with China, which in turn would enable smoother patrolling by Indian troops while preventing clashes with Chinese soldiers, The Indian Express has learnt.

This, along with increased surveillance, regular patrolling, frequent interaction between Indian and Chinese commanders at various levels and readjustment of Indian troops stationed along the LAC are among the tactical developments brought in by India in the last six months.

On October 21 last year, Indian and Chinese negotiators had arrived at an agreement on patrolling arrangements along the LAC, which led to “disengagement and a resolution of the issues that had arisen in these areas in 2020”.

This announcement was made by India and it was followed by a bilateral meeting between Prime Minister Narendra Modi and China’s President Xi Jinping on the sidelines of the BRICS leaders’ summit in Kazan, Russia.

By the end of October, officials said that both sides had completed the disengagement process and sweets were exchanged between both sides. They said the disengagement would be first verified on ground before resumption of patrolling and that the patrolling modalities would be decided between ground commanders.

Days later, the Army said it had successfully patrolled one of the five patrolling points in the Depsang area of eastern Ladakh — a first since the standoff began in 2020.

India and China have always had differing perceptions of the LAC. Sources in the government said that while certain mountain features along the border are clearly identifiable, there were varying opinions on others, which were discussed in multiple rounds of military and diplomatic-level talks between India and China.

Sources told The Indian Express that both sides have agreed to limit the frequency of patrolling to twice a month to each Patrolling Point along the LAC in eastern Ladakh.

They said that patrolling plans will be exchanged in advance between both sides to avoid a confrontation. “The troops have been asked to avoid physical contact with Chinese troops and in case of any engagement, stay 200 metres away, take photographs and come back to report,” a source said.

“It was decided that the Commanding Officers (COs) of the units posted there would interact once or twice a month, and Brigade Commanders would do so every quarter. Major Generals and above would hold interactions with their Chinese counterparts as and when required,” the source said.

Geotagging existing patrolling points, key features and landmarks, will help demarcate the LAC clearly, aiding easier identification of disputed areas along the LAC for future talks aimed at resolution.

Additionally, multiple new drones of various sizes have been procured in recent months by the Army for effective monitoring of the LAC. This would help reduce the frequency of Army foot patrols without compromising on surveillance of sensitive areas along the border.

A range of cameras have also been installed along the LAC and adequate helicopter sorties are being carried out in the region for surveillance and monitoring of the LAC. Adequate creation and enhancement of infrastructure will continue along the LAC, including along the routes of troop induction.

There is a possibility that exercises held by the Armed Forces in the area might go down as part of the disengagement process. Other confidence building measures will continue, sources said.

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AI-driven security

Source: The Statesman, Dt. 29 April 2025,
URL: https://www.thestatesman.com/opinion/ai-driven-security-1503426197.html

On 22 April, the pristine calm of Baisaran Valley near Pahalgam was ruptured by violence of the most brutal kind. In what is now being called the deadliest civilian-targeted terrorist attack in India since 2008, twenty-six tourists, including a child and a Nepalese national, were murdered in cold blood by militants claiming allegiance to The Resistance Front (TRF), a known proxy of Lashkar-e-Taiba of Pakistan. This was not just an act of horrendous terror. For India, it was a catastrophic intelligence failure, a security breach of the highest order, and a national tragedy with profound strategic consequences.

India, a nuclear-armed state with one of the world's largest standing militaries and a formidable intelligence network, failed to foresee an attack in one of the most heavily patrolled and sensitive regions of the country. This is India's "zero-day" event ~ a term borrowed from cybersecurity, referring to a previously unknown vulnerability exploited by attackers before a patch can be issued. Kashmir's picturesque façade had, perhaps, lulled policymakers into a misplaced sense of normalcy. But beneath it, as this attack showed, lay dormant terror networks waiting for their opportunity. The question India must now ask ~ calmly, seriously, and strategically ~ is this: how can India predict and prevent the next zero-day attack?

The answer lies not just in more boots on the ground, but in more intelligence, more integration, and more technology. India must now make a decisive shift toward AI-enhanced national security ~ learning from global counterparts like Israel and the United States, who have integrated artificial intelligence deeply into their counterterrorism frameworks. India's counterterrorism strategy remains a mix of centralized intelligence agencies ~ RAW, IB, NIA ~ and military deployment in volatile areas like Jammu and Kashmir. But this system is often reactive, bureaucratic, and siloed. It is good at response but poor at prediction.

It can investigate what happened, but it struggles to see what is about to happen. It responds to threats but does not proactively hunt for threats and stop them before they strike. Moreover, the focus in Kashmir over the past few years has tilted toward infrastructure development and tourism promotion. While such soft power strategies are essential, they must be accompanied by upgraded surveillance and threat anticipation mechanisms, especially in remote, high-value areas. The Baisaran Valley, accessible only by foot or horseback and surrounded by thick forest, became an unguarded zone ~ a perfect target for asymmetric warfare.

The terrorists understood this. India didn't. Israel, a country with a fraction of India's resources but a far more existential security environment, offers one model. Its intelligence agency, Unit 8200, leverages AI to analyze phone metadata, satellite imagery, and online communication to detect behavioral anomalies. These are cross-referenced with historical patterns of insurgent activity, allowing the Israeli Defense Forces (IDF) to preempt attacks with precision. Its smart border systems, powered by thermal imaging and computer vision, are capable of detecting and classifying movement ~ human, animal, or vehicular ~ within seconds. In high-risk zones, these tools are not experimental; they are operational doctrine.

The United States, particularly through its Department of Defense's Project Maven, uses AI to analyze drone footage in real time. This allows for the identification of vehicles, weapons, and human activity in conflict zones without delay. Combined with generative AI's natural language processing (NLP) systems that monitor opensour ce intelligence ~ forums, encrypted platforms, and deep web chatter ~ U.S. counterterrorism forces can often intercept plots before they become operations.

Additionally, agencies like the National Security Agency (NSA) and Department of Homeland Security (DHS) employ predictive policing tools that flag domestic and foreign threats based on behavioral analytics and travel history ~ tools that have become controversial but effective in high-stakes national security scenarios. How can AI help India? India, with its vast pool of engineers, data scientists, and AI startups ~ not to mention military R&D through DRDO ~ has the capacity to

build and deploy such systems. What's missing is strategic urgency and political coordination. Here are five immediate applications of AI for counterterrorism India must adopt:

- Predictive Modeling: AI can detect anomalies in movement patterns, communication behaviour, and online activity. Unusual visits to forests, encrypted group chats discussing sensitive areas, or route mapping behavior can all trigger early warnings.
- Drone ISR (Intelligence, Surveillance, Reconnaissance): Autonomous drones equipped with computer vision can patrol valleys like Baisaran, instantly alerting command centers to suspect gatherings, gunfire, or unauthorized movement.
- Facial Recognition and Biometric Verification: AI can crosscheck surveillance camera footage from bus stations, hotels, and shrines against national watch-lists.
- Social Media and Dark Web Monitoring: Natural Language Processing (NLP)-powered systems should scan for coded language, propaganda, or radicalization narratives in local languages, Kashmiri, Urdu, Punjabi, etc., across all platforms and apps.
- Smart Border Defense: Thermal and radar-based AI systems must be deployed in terrain accessible infiltration zones, with alerts routed through a centralized AI-powered military operations center. Adopting AI isn't just about buying new software or hardware. It requires institutional transformation. India should establish a National AI Command Centre ~ a nodal agency integrating data from RAW, IB, state police, satellite feeds, and cyber intelligence.

This agency must operate with both speed and accountability, combining AI with human judgment. Equally important, nonetheless, is the question of civil liberties. AI systems can be misused or biased.

There must be legal safeguards, ethical frameworks, and parliamentary oversight, particularly when surveillance extends into civilian domains. The tragedy in Baisaran Valley must not be reduced to a news cycle. It should be treated as a wake-up call ~ a signal that India's security model must evolve from manpower-intensive response to technology-led preemption.

In the 21st century, terrorism wars are won not just by armies, but by algorithms. The next terrorist attack is being planned in silence. India's response must begin in urgency. Diplomatic measures are necessary ~ but not sufficient. India's diplomatic retaliation post-Pahalgam ~ expulsions, visa cancellations, Indus Water Treaty suspensions ~ sends a strong geopolitical signal.

However, it does little to stop the next attack. The Pahalgam atta ck was not only a tragedy ~ it was a test. A test of India's ability to use modern AI technology to foresee and forestall, to nip evil in the bud. India failed to foresee this zero-day event. But India must not fail again.

A new doctrine must emerge ~ one that places AI at the centre of national security, not just as a tool, but as a philosophy. From space-based surveillance to drone ISR, from behavioral analytics to cyber intelligence, AI can help India do what it could not do in Pahalgam: see it coming. The next move belongs to India.

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Drones are changing war and India must catch up

Source: The Tribune, Dt. 29 April 2025,
URL: https://www.tribuneindia.com/news/comment/drones-are-changing-war-and-india-must-catch-up/

IN a seminar hosted by the Centre for Joint Warfare Studies on March 10, General Anil Chauhan, India's Chief of Defence Staff, emphasised the transformative role of unmanned aerial systems, commonly known as drones, in modern warfare and called for doctrinal clarity on the employment of drones.

Drones have been around for decades in the military arsenal of countries. What is new is the extensive use of drones in the Russia-Ukraine war, from the tactical battlefield to achieving strategic effects. As the Indian military increasingly looks to induct drones into service, key insights from the Ukraine conflict should guide this effort.

The start of the Ukraine war saw the traditional employment of large, slow-flying drones, like Ukraine's Bayraktar TB2 and Russia's Orion, in surveillance and strike roles. However, these drones were vulnerable to air defence systems and soon disappeared from the skies, replaced by smaller military drones, like the Ukrainian Furia and the Russian Orlan-10.

The real transformation occurred when Ukraine turned to commercial off-the-shelf drones, repurposing thousands of them as combat tools. By the war's second year, drone operations had massively expanded in scale and sophistication. In 2023, the Ukrainian army raised over 60 special drone strike units embedded in combat brigades and independent drone groups, institutionalising drone warfare.

With the increasing role of drones on the battlefield, their numbers expanded exponentially. Oleksandr Syrskyi, Ukraine's commander-in-chief, said over 1.3 million drones had been delivered to frontline soldiers in 2024. Russian President Vladimir Putin has stated that Russia was ramping up its drone production to nearly 1.4 million in 2024, a tenfold increase from the previous year.

Today, small quadcopters costing less than $1,000 dominate the tactical battlefield, carrying out a variety of roles —intelligence, surveillance, target acquisition and kinetic strikes. This omnipresence of drones has dramatically compressed the kill chain: spotting a target and directing fire on it is often done in just minutes or even seconds. A February 2025 study by the Royal United Services Institute estimates that tactical drones account for 60 to 70 per cent of the damaged and destroyed Russian systems.

Russia's success in driving Ukrainian forces out of Kursk in March 2025 has been attributed to the mass employment of fibre-optic drones. These drones are tethered to their operator via a physical cable and are immune to electronic jamming. Ukraine troops described their retreat from Kursk as a "horror movie" as drones "hunted them day and night."

Drones have also had strategic impacts away from the frontlines. Ukrainian uncrewed surface drones (USVs) have sunk Russian warships, compelling Russia to relocate much of its Black Sea fleet to ports like Novorossiysk, effectively ceding control of large parts of the Black Sea. USVs carrying drones have attacked Russian gas platforms and other targets around the Black Sea.

As drones proliferate in the Indian military, they must not be treated as standalone assets but integrated into a combined arms operation. The control of thousands of drones in the sky will require a network-centric approach to manage the information overload. Ukraine has adopted the DELTA system, which integrates data from multiple sources, including drone video feeds, open-source intelligence and satellite imagery, to present a real-time picture to commanders, enabling quick targeting.

A current deficit in India's military power is the limited inventory of conventional missiles for engaging targets deep in enemy territory. Long-range strike drones can fill this gap. According to a report by the Center for Strategic and International Studies, Russia carried out 8,484-long-range strikes against Ukraine between September and December 2024.

More than 90 per cent of these strikes were carried out by attack drones, mostly Shahed drones imported from Iran. While relatively slow and often intercepted, the Shaheds are cheap (about $35,000 each) and are being used in large numbers as expendable cruise missiles. As a comparison, Russian missiles like the ground-launched Iskander and air-launched

Kh-22 cost around $10,00,000.

Technology sans doctrine is of little use. The Indian military will have to evolve a comprehensive doctrine around drone warfare. Constant surveillance over the battlefield and the ability to quickly hit individual targets is forcing troops to disperse and remain hidden, making mass surprise attacks difficult. The operational tempo and decision cycles have compressed, requiring greater delegation and initiative from local commanders. Fundamental changes would have to be made in how the Army fights.

In a highly contested airspace and a plethora of air defence systems, drones will play a key role in deep observation and targeting. The Air Force will have to develop doctrines for manned-unmanned teaming of fighter aircraft and drones.

The drones will carry out the role of surveillance, electronic warfare and other risky tasks while the manned aircraft deliver strategic strikes. Strategies will also have to be formulated for defending airspace from mass drone attacks. An effective defence will require a layered approach, combining detection, disruption and destruction, with electronic warfare as a critical component.

The Navy will have to integrate drones as strategic strike assets while reviewing the concept of coastal and harbour defence to protect from attacks by surface or underwater drones. Like the Air Force, the Navy must look at the concept of manned-unmanned teaming in fleets.

Organisational changes must accompany doctrinal development. Merely allocating drones to existing units will result in suboptimal employment. Specialised drone units will have to be created within all three services and there will be a requirement to raise additional electronic warfare and counter-drone units.

Such a proliferation of roles will require mass manufacturing of drones and production capacity will have to be ramped up quickly. This necessitates an extensive participation of the civil sector and changes in the defence procurement process to make it more agile.

The jury is still out on whether drones have completely transformed how future wars will be fought, but it is a reality that drone warfare has become a central feature of modern combat. The Indian military must put doctrines and organisational structures in place to exploit this new weapon of war.

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Indian Naval Officer pays courtesy visit to Maldives defence officials

Source: ANI News, Dt. 29 April 2025,
URL: https://www.aninews.in/news/world/asia/indian-naval-officer-pays-courtesy-visit-to-maldives-defence-officials20250429034102/

The Commanding Officer of INS Kochi, an Indian naval ship, on Monday, paid a courtesy call on senior defence officials of the Maldives in Male.

He met with Maldives National Defence Force (MNDF) Chief Maj Gen Ibrahim Hilmy, Vice Chief of Defence Force (VCDF) Brig Gen Ahmed Ghiyas, and Commandant Coast Guard, Brig Gen Mohamed Saleem.

Commanding Officer of INS Kochi paid a courtesy call on MNDF Chief of Defence Force Maj Gen Ibrahim Hilmy, VCDF Brig Gen Ahmed Ghiyas and Commandant Coast Guard, Brig Gen Mohamed Saleem.

"Commanding Officer of INS Kochi paid a courtesy call on MNDF Chief of Defence Force Maj Gen Ibrahim Hilmy, VCDF Brig Gen Ahmed Ghiyas and Commandant Coast Guard, Brig Gen Mohamed Saleem," the Indian High Commission in Maldives wrote on X.

Indian Navy's Destroyer INS Kochi reaches Malé, accompanying Maldives CGS Huravee upon completion of refit in India.

This visit underscores our deep-rooted friendly ties and multi-faceted defence cooperation.

Earlier in the day, the Indian Navy's Destroyer INS Kochi reached Male, accompanying Maldives CGS Huravee upon completion of refit in India.

This visit underscores the deep-rooted, friendly ties and multi-faceted defence cooperation.

Earlier n January, Maldives Minister Maumoon was on his first official visit to India, where he held bilateral discussions with Defence Minister Rajnath Singh.

During the meeting, India handed over defence equipment and stores to the Maldives, as per the island nation's request.

Both sides comprehensively reviewed various aspects of bilateral defence and security cooperation and reasserted the firm commitment to work closely in realising the joint vision for the India-Maldives Comprehensive Economic and Maritime Security Partnership, the Ministry of External Affairs said in a statement.

Minister Maumoon appreciated India's historical role as the 'First Responder' for the Maldives and thanked New Delhi for assisting Male in augmenting the modern infrastructural capacities and training of defence & security personnel.

The visit was part of continued high-level engagements between the two sides. It has provided an opportunity to further deepen the bilateral defence and security ties for the mutual benefit of the two countries and the Indian Ocean Region.

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Amid India-Pakistan Tensions, Saab Delivers AT4 Anti-Armor Weapon System To Indian Military Ideal For Short-Range Combat

Source: The EurAsian Times, Dt. 28 April 2025,
URL: https://www.eurasiantimes.com/amid-india-pakistan-tensions-saab-delivers-deadly-at4/

In an X post, SAAB India said, “We are proud to announce the successful delivery of our AT4 anti-armour weapon system to the Indian Armed Forces. Selected through a competitive evaluation, AT4 joins India’s arsenal as a trusted single-shot solution for short-range combat. India has procured the AT4CS AST variant, specifically designed for confined space operations—including use from within buildings, bunkers, and other urban environments. This marks a milestone moment as the Indian Armed Forces, long-standing users of our Carl-Gustaf system, extend their trust to our AT4 weapon system as well.

Earlier, SAAB, on January 20, 2022, announced it had been awarded a contract for supplying the AT4, the 84 mm single-shot weapon, to the Indian Army and the Indian Air Force.

The contract was awarded after a competitive procurement process. The order included the variant for urban warfare, the AT4CS AST (anti-structure tandem warhead). This can be fired from inside confined spaces like buildings and bunkers to provide destructive firepower to Infantry or counter-terrorist forces.

“The AT4CS AST offers a tandem warhead with a breach or blast mode, which is optimised to defeat enemies within buildings and to destroy structures, which can create a point of access into them,” Saab stated. This makes it useful for counter-terrorist operations in urban settings in which terrorists often use the cover of built-up spaces in crowded localities.

Variants of these man-portable weapons weigh up to 7.5 kg and are disposable after a single shot. This recoilless weapon is operated by a single soldier.

SAAB India has announced that it delivered AT4 anti armour weapon system to the Indian Armed Forces.

The AT4 is one of the most popular support weapons for ground forces. It is also used by the US, French, and Swedish Armies. India is a new customer but has long been using the Saab-designed

Carl-Gustaf shoulder-fired weapon system, which is produced by Bharat Dynamics in India. The AT4 has features of the Carl-Gustaf.

"We are honoured that the Indian Armed Forces, which are already users of our Carl-Gustaf system, have also selected Saab for their single-shot weapon need. The Indian Army and Indian Air Force can be confident in the knowledge that they have the necessary firepower to give them the advantage," said Görgen Johansson, head of Saab's business area Dynamics.

"The AT4 systems are combat-proven across the world. They are lightweight, single-shot, fully disposable, and truly characterized by their ease of use and handling. This selection of the system through a competitive process underscores Saab's commitment to bringing to Indian forces the latest systems," said Ola Rignell, Chairman and Managing Director at Saab India.

The AT4 is an 84mm unguided anti-armour, anti-structure weapon. It is effective in assaulting tanks, combat vehicles, landing craft, helicopters, aircraft, and armored vehicles, as well as destroying structures.

Aiming is facilitated through range-adjustable plastic sights, which can be covered by sliding covers. The weapon is equipped with an optical night sight. The AT4 warhead can penetrate through more than 17.5 inches of armour. The weapon has a minimum arming distance of 10m, which makes it suitable for hitting targets at short distances.

The AT4 can be fired with a range of projectiles, including HEAT (high-explosive anti-tank), AST (anti-structure tandem-warhead), ER (extended range), HE (high-explosive), HP (high penetration), and RS (reduced sensitivity). The projectile is preloaded into the launcher.

The AT4-CS (confined space) variant eliminates backblast, enabling it to be fired from indoors to meet urban warfare requirements. AT4-CS uses a saltwater countermass, which absorbs the backblast and slows down the pressure wave. It can be used against targets up to 270 metres.

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Turkey Rejects Sending Arms & Ammo To Pakistan; Admits Cargo Aircraft Landed In The Country

Source: The EurAsian Times, Dt. 28 April 2025,
URL: https://www.eurasiantimes.com/turkish-transport-aircraft-lands-in-pakistan-amid-indo-pak-tensions/

Multiple reports circulating on social media claimed that a Turkish C-130E Hercules landed in Karachi, allegedly to deliver military equipment. The reports were based on flight-tracking data published by open-source intelligence (OSINT) trackers. The aircraft was seen flying over the Arabian Sea on April 28. Some reports in the Indian media went on to claim that six, and not one, C-130Es landed in Pakistan. The speculation sparked a storm on X, with several Indian academicians, military analysts, geopolitical experts, and netizens expressing alarm over the development.

However, the claims were refuted by the Presidency's Directorate of Communications. "A cargo plane from Türkiye landed in Pakistan for refueling. It then continued on its route. Speculative news made outside of the statements of authorized persons and institutions should not be relied upon."

The Pahalgam terror attack has triggered a fresh spate of tensions between India and Pakistan, with clouds of a potential war looming large over the South Asian subcontinent. Fearing an attack from the Indian military (as seen in the past after the Uri and Pulwama terror attacks in Kashmir), the Pakistani military remains on high alert.

Latest reports and visuals on social media indicate that it has started moving military equipment in the Pakistan-controlled Kashmir region and activated its Pensi, Skardu, and Swat air bases. Notably, the reports about Turkey delivering military cargo to Pakistan come after similar reports hinting that China is delivering the PL-15 long-range missile to Pakistan. Beijing has not commented on the reports so far.

Turkey, like China, is a close ally of Pakistan. The two countries have strong military cooperation, based on their shared vision of assuming leadership in the Islamic world. Turkey has expressed support for Pakistan on the Kashmir issue. In February 2025, following his talks with Shahbaz Sharif, Turkish President Recep Tayyip Erdoğan called for a UN dialogue to resolve the Kashmir issue. Separately, just hours after the Pahalgam terror attack, Pakistani PM Shehbaz Sharif thanked Turkey for its "unwavering support" on Kashmir during a meeting with Erdoğan in Ankara.

While this does not automatically confirm a Turkish arms shipment, the speculation aligns with the fact that the diplomatic and military ties between the two allies remain 'very strong'.

Pakistan-Turkey Defense Relations

Pakistan and Turkey are close allies. In 2021, the two states signed a formal agreement to enhance defense cooperation through joint arms manufacturing and have since made concerted efforts to increase engagement and collaboration. According to the SIPRI (Stockholm International Peace Research Institute) report published in March 2025, 10% of Turkey's total arms shipments went to Pakistan between 2020 and 2024.

Drones

Turkey has established itself as a leading player in the global market for armed drones. Pakistan has purchased Bayraktar TB2 drones and Akinci drones from Turkey in the last couple of years. Of these, the TB2 rose to global prominence following their combat success in conflicts such as the 2020 Nagorno-Karabakh War, where Azerbaijan used them effectively against Armenian forces.

Pakistan gets Turkiye's Baykar Bayraktar Akıncı drones

In 2023, Pakistan also received its first batch of Bayraktar Akinci combat drones from Turkey. The Akinci, meaning "Raider" in Turkish, is a High-Altitude Long-Endurance (HALE) Unmanned Aerial Vehicle (UAV) designed for air-to-air and air-to-ground combat, equipped with a diverse range of missiles.

It is pertinent to note that Pakistan has been focusing on incorporating drones into its military strategy. It has expanded its drone operations and has carried out numerous strikes against militant organizations not only within its borders but also across regional theaters, including Afghanistan.

Combat Aircraft

Besides drones, Pakistan and Turkey are collaborating on the fifth-generation KAAN aircraft. The two sides discussed the potential export of Turkey's KAAN fifth-generation fighter jet to the Pakistani Air Force (PAF) during the eighth Pak-Turk Industrial Expo Joint Working Group meeting, held in Pakistan earlier this year.

Reports indicate that the two allies were reportedly set to establish and operate a joint factory to produce the KAAN fighter jet. In addition to exploring the potential export of KAAN to Pakistan, both nations are reportedly also discussing the design and co-development of a new helicopter.

Turkey has also assisted Pakistan in upgrading its F-16 fighter jets. Pakistan's Ministry of Defense awarded TAI a contract worth US$75 million in 2009 to upgrade the avionics and structural systems of 41 PAF F-16s, extending their operational life and improving their capabilities. The deal also covered pilot training on the improved aircraft. Ankara delivered the last four upgraded F-16 Fighting Falcon aircraft to the Pakistan Air Force (PAF) in 2014. Additionally, the PAF was believed to be converting its lone Bombardier Global 6000 into a stand-off jamming (SOJ) aircraft with the assistance of Turkish Aerospace Industries (TAI).

Munitions

Pakistan has purchased munitions for different platforms from Turkey. Reports in November 2023 indicated that Pakistan was buying anti-tank guided weapon systems (ATGWs) from Turkish Rokestan. While the names of these missiles were not disclosed, Rokestan manufactures Karaok, Omtas, and Umtas. The co-production of the ATGMs was also on the cards, according to reports.

Islamabad has reportedly purchased the Turkish Kemankeş cruise missiles from the Turkish company Baykar for the UAVs it has purchased. Characterised by its AI system, the missile can reportedly be integrated with both TB2 and Akinci drones.

Additionally, the two sides are believed to be collaborating on the development of air-to-air missiles, including both short-range and beyond-visual-range (BVR) variants. Under this partnership, missiles such as Pakistan's FAZ-2 and Turkey's Gökdoğan are being developed, and a technology exchange is taking place.

Ships For the Pakistan Navy

Pakistan has also acquired four MILGEM-class corvettes, the most technologically advanced surface platforms constructed for the Pakistan Navy. The last of the four corvettes, PNS Tariq (283), was delivered to the Pakistan Navy in August 2023.

Turkey has also upgraded Pakistan's Agosta 90B-class submarines, and the two sides were previously known to be discussing the joint development of new submarines, including nuclear-powered submarines. The modernization included comprehensive enhancements to vital systems,

such as radar, periscopes, command and control, data distribution, steering control, cooling, and sonar.

In addition to the above, Turkey delivered a fleet tanker to the Pakistan Navy, which is the largest ship in the Pakistani Navy. Known as PNS Moawin, the tanker was designed by the Turkish firm, STM, and constructed by Karachi Shipyard and Engineering Works in Karachi, Pakistan.

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Science & Technology News

Towards a new approach for green hydrogen production

Source: Press Information Bureau, Dt. 28 April 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2124882

Researcher have developed fresh insights into proton adsorption behaviour at the surface of catalysts, which can help construct electrocatalysts useful for producing green hydrogen.

Plethora of heterostructures have been studied for green hydrogen generation with the effect of built-in electric field (BIEF). However, the metal-oxide-semiconductor (MOS) based p-n heterojunction can be considered as a promising material to have robust BIEF due to asymmetric electronic environment.

Recent research is focused on leveraging BIEFs at the interface of different electronic environments to improve hydrogen production. Therefore, analysing and correlating parameters such as the work function, BIEF, and Gibbs free energy (a thermodynamic potential that can be used to calculate the maximum amount of work) is crucial for understanding the reaction mechanism.

The difference in work functions between two materials is what drives the initial charge redistribution, which in turn sets up the built-in potential across the junction. BIEF directly affects the dynamics of proton adsorption/desorption, which was evaluated by Gibbs free energy of adsorption.

Scientists of Institute of Nano Science and Technology (INST), Mohali, grew CuWO4 (Copper tungsten oxide) nano-particles precursor over Cu (OH)2 (Copper hydroxide) and fabricated CuWO4-CuO hetero-structure and studied its physical and electrochemical properties.

They examined the Gibbs free energy profile for proton adsorption of different regiones and found that near the depletion region and along the interface, the proton adsorption energy shows contrasting behaviour as compared with bulk area. This induces a gradient in Gibbs free energy across and near the depletion region, thereby promoting an improved hydrogen adsorption and desorption.

Interestingly, Scientists from INST, an autonomous institute of the Department of Science and Technology (DST), demonstrated that the interplay between the built-in electric field (BIEF) and Gibbs free energy in the proposed catalyst gives rise to a favourable regime, where hydrogen bonding to the catalyst is optimized, facilitating efficient hydrogen evolution.

They also found that along the heterojunction interface, the ΔG indicates high adsorption affinity of protons toward the CuO phase and significant desorption at the CuWO4 phase. The CuO-$CuWO_4$ catalyst unveils an excellent example of 'negative cooperativity,' in which the binding of one molecule decreases the affinity of other binding sites for additional molecules. With more and more proton coverage, the affinity of the catalyst's surface towards the proton adsorption decreases, and promotes alkaline Hydrogen Evolution Reaction by enhancing desorption.

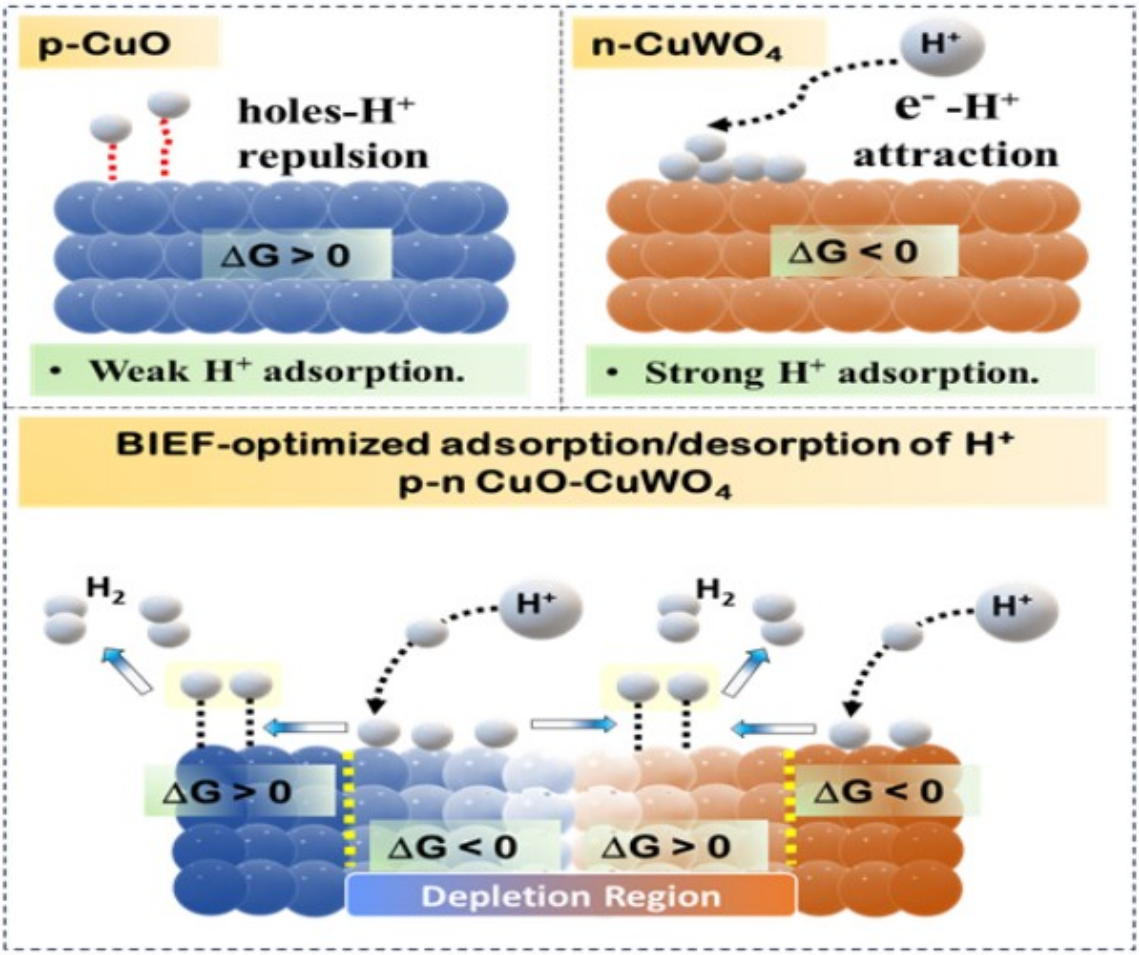

Fig: *Mechanism revealing an interplay of BIEF and Gibbs Free Energy in CuO-$CuWO_4$ p-n heterojunction for proton adsorption/desorption in HER.*

This research published in Adv. Energy Mater. 2025 helped understand the typical proton adsorption behaviour at the surface of the catalyst, which can help others to design and construct similar electrocatalyst which can give robust activity to produce green hydrogen. Improving in electrocatalytic hydrogen production can lead to sustainable environment with advance green technologies.

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Explainer: Why the second stage of the GSLV Mk II rocket is crucial to the NISAR Mission

Source: The Week, Dt. 28 April 2025,
URL: https://www.theweek.in/news/sci-tech/2025/04/28/explainer-why-the-second-stage-of-the-gslv-mk-ii-rocket-is-crucial-to-the-nisar-mission.html

India is preparing for one of its most important space missions the launch of the NASA-ISRO Synthetic Aperture Radar (NISAR) satellite scheduled for June 2025.

The rocket that will carry this high-tech satellite is the Geosynchronous Satellite Launch Vehicle Mark II (GSLV Mk II), which has been developed by the Indian Space Research Organisation (ISRO).

The GSLV Mk II is a three-stage rocket with four liquid strap-on boosters. It stands 50.9 metres tall and is capable of carrying 2,500 kilograms to a Geosynchronous Transfer Orbit (GTO) or 5,000 kilograms to a Low Earth Orbit (LEO). Each stage of the rocket plays a key role, but the second stage (GS2) acts as a critical bridge between the powerful liftoff and the precision needed to place satellites into orbit.

The first stage of the GSLV uses a solid-fuel motor, assisted by four liquid-fueled boosters, to produce the initial thrust needed to escape Earth's gravity. After this stage burns out, the GS2 takes over and continues to power the rocket upward.

The GS2, or second stage, uses a Vikas engine, which has been a reliable workhorse in many of ISRO's past launches. It runs on liquid propellants—unsymmetrical dimethylhydrazine (UDMH) as fuel and nitrogen tetroxide (N_2O_4) as oxidiser. These are hypergolic propellants, meaning they ignite automatically upon contact with each other, which adds to their reliability and ease of ignition in space.

The GS2 burns for about 150 seconds, providing a steady and controllable thrust that helps the rocket maintain its correct path through the atmosphere. It is during this stage that the rocket must travel through the upper layers of Earth's atmosphere, where aerodynamic forces are still active and corrections in the flight path may be needed. Unlike solid motors, which cannot be adjusted once fired, the liquid propulsion in GS2 allows for fine control, enabling the rocket to correct any early flight deviations.

Then comes the third stage (GS3), which is powered by cryogenic propellants—liquid hydrogen (LH2) and liquid oxygen (LOX). These are stored at extremely low temperatures and are more efficient than conventional fuels. The GS3 burns for around 720 seconds (12 minutes), giving the final push needed to insert the satellite into its precise orbit. This indigenously developed cryogenic stage is a significant achievement for India, marking self-reliance in advanced rocket technology.

But for the third stage to do its job properly, the second stage must first lift the rocket to the right altitude and velocity. If the GS2 underperforms, the cryogenic stage won't have enough energy or time to adjust the satellite's orbit. A similar issue happened in 2021 when the GSLV-F10 mission carrying the EOS-03 satellite failed due to a cryogenic stage malfunction. Though the issue lay in

the upper stage, it reminded everyone how each stage of a rocket is interconnected—a failure in one part can jeopardize the whole mission.

On March 24, 2025, ISRO successfully flagged off the GS2 stage from its Propulsion Complex in Mahendragiri, Tamil Nadu, and transported it to the launch site at Sriharikota, marking a key milestone in the GSLV-F16 mission preparation. This readiness reflects ISRO's engineering discipline, technical expertise, and high safety standards.

The upcoming launch will carry NISAR, a joint mission between NASA and ISRO. This satellite will monitor changes on Earth, such as deforestation, melting glaciers, natural disasters, and infrastructure development. It will orbit the Earth at a height of 747 km in a sun-synchronous polar orbit, using two radars L-band from NASA and an S-band from ISRO to scan the planet every 12 days, offering high-resolution data between 5 and 10 metres.

"Placing this advanced satellite in such a specific orbit requires flawless performance from each rocket stage, especially the GS2. The second stage determines whether the cryogenic engine can take over successfully. Any delay or deviation in this phase can compromise the final outcome," remarked space expert Girish Linganna.

He also adds that the GS2's contribution also highlights India's growing mastery of liquid propulsion systems, which are not only more precise but also more complex to manage. "Building, assembling, fuelling, and testing a liquid stage involves great care to prevent leaks, pressure failures, or engine shutdowns. The successful handling of GS2 proves that ISRO is ready for the next level of space missions, including human spaceflight (Gaganyaan) and commercial launches through NewSpace India Limited (NSIL)," added Linganna.

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Microgravity research experiments proposed by IISc. and UAS Dharwad to be conducted on board International Space Station

Source: The Hindu, Dt. 28 April 2025,
URL: https://www.thehindu.com/sci-tech/science/microgravity-research-experiments-proposed-by-iisc-and-uas-dharwad-to-be-conducted-on-board-international-space-station/article69500462.ece

Indian Space Research Organisation (ISRO) has shortlisted seven microgravity research experiments, which are expected to be conducted on board the International Space Station (ISS) during the upcoming Axiom-4 mission (Ax-4).

The upcoming Ax-4 mission, with Indian astronaut Group Captain Shubhanshu Shukla, is the fourth private astronaut mission to the ISS. The mission is likely to be launched in May.

According to ISRO, it has shortlisted seven microgravity research experiments proposed by Indian Principal Investigators (PIs) from various national R&D laboratories and academic institutions for implementation on the ISS.

Of these R&D laboratories and academic institutions, three — Indian Institute of Science (IISc), Institute of Stem Cell Science and Regenerative Medicine (InStem), and University of Agricultural Sciences, Dharwad — are based in Karnataka.

The shortlisted seven microgravity research experiments are:

1. Impact of Microgravity Radiation in ISS on Edible Microalgae by International Centre for Genetic Engineering & Biotechnology (ICGEB) and National Institute of Plant Genome Research, Sprouting Salad Seeds in Space
2. Comparative growth and proteomics responses of cyanobacteria on urea and nitrate in microgravity by ICGEB
3. Relevance to Crew Nutrition by University of Agricultural Sciences, Dharwad
4. Survival, revival, reproduction, and transcriptome of the eutardigrade Paramacrobiotus sp. BLR strain in space by IISc
5. Analyzing Human Interaction with Electronic Displays in Microgravity by IISc
6. Effect of metabolic supplements on muscle regeneration under microgravity by Institute of Stem Cell Science and Regenerative Medicine (InStem)
7. Impact of Microgravity on Growth and Yield Parameters in Food Crop Seeds by Indian Institute of Space Science and Technology (IIST), Dept. of Space & College of Agriculture, Vellayani, Kerala Agricultural University

According to ISRO, the field of microgravity research, with potential applications in diverse areas such as human health, physical and life sciences, material research, novel pharmaceutical development and biotechnology, offers significant opportunities to the national scientific community. These experiments will utilise available research facilities on board ISS.

The experience gained through this effort in implementation of these experiments is expected to nurture a microgravity research ecosystem in India resulting in the induction of advanced microgravity experiments in various disciplines in the Indian space programme.

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Scientists unveil Artificial Leaf that turns sunlight into valuable chemicals

Source: News Nine, Dt. 28 April 2025,
URL: https://www.news9live.com/science/scientists-unveil-artificial-leaf-that-turns-sunlight-into-valuable-chemicals-2844112

Researchers at Lawrence Berkeley National Laboratory developed an innovative artificial leaf system which imitates photosynthesis processes at their research facility. The innovative device uses sunlight to create carbon dioxide conversion into liquid fuel and useful chemical compounds, which could lead to new manufacturing methods with decreased carbon pollution.

The Nature Catalysis journal recently released research which marked a substantial achievement toward scientists replicating natural photosynthetic efficiency. The combination of copper catalysts with perovskite materials enables researchers to build a single system that generates carbon-carbon (C2) compounds using solar power.

Multi-institutional collaboration drives innovation

The development emerged from research within the Liquid Sunlight Alliance (LiSA), which the Department of Energy funded as a leadership programme between Caltech and Berkeley Lab. More than 100 scientists representing SLAC and four other research institutions, including the National Renewable Energy Laboratory, UC Irvine, UC San Diego and the University of Oregon, unite through this project.

According to Peidong Yang, who serves as senior faculty scientist at Berkeley Lab and UC Berkeley professor, nature served as the source of his inspiration. The first step focused on developing individual components, yet the moment we successfully integrated them all became incredibly thrilling.

Mimicking nature with modern materials

Researchers precisely rebuilt the fundamental elements of natural photosynthesis for their artificial leaf development. The artificial leaf contains photo absorbers based on lead halide perovskites which replace chlorophyll functions and uses designed copper electrocatalysts resembling flower shapes that mimic natural enzyme behaviour.

The main uniqueness of this innovation involves substituting biological materials with inorganic copper. The lower selectivity of copper-based systems relative to biological solutions comes with superior durability and stability, which makes copper suitable for practical applications.

A step toward scalability

A postage stamp-sized device shows major progress in sustainable chemistry, which produces C2 chemicals that enable the production of numerous industrial building blocks. Plastic polymers require these compounds as essential precursors, and these materials could generate fuel for aircraft that operate beyond battery capabilities. The research team of Yang focuses on system enhancement for practical industrial use to decrease carbon emissions and produce valuable renewable solar energy products.

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Printing the Future of Life: How 3D Collagen Scaffolds Grow Real Tissues

Source: SciTech Daily, Dt. 28 April 2025,
URL: https://scitechdaily.com/printing-the-future-of-life-how-3d-collagen-scaffolds-grow-real-tissues/

Researchers at the University of Pittsburgh have created a groundbreaking tissue engineering platform using 3D-printed collagen scaffolds called CHIPS.

By mimicking natural cellular environments, they enable cells to grow, interact, and form functional tissues — a major step beyond traditional silicone-based microfluidic models. The platform not only models diseases like diabetes but could also replace animal testing in the future. Plus, their designs are freely available to fuel broader scientific innovation.

3D Bioprinting: Turning Science Fiction Into Science Reality

Creating organic tissue models that behave like living organs might sound like science fiction, but engineers at the University of Pittsburgh are turning it into reality.

At the heart of their breakthrough is a powerful concept: given the right environment, cells naturally know how to organize and function. The key is designing scaffolds that mimic the body's natural structures, providing the cues cells need to grow, interact, and form tissues.

Daniel Shiwarski, an assistant professor of bioengineering at the Swanson School of Engineering and a faculty member at the School of Medicine's Vascular Medicine Institute, developed a new type of scaffold called "CHIPS" — collagen-based, high-resolution, internally perfusable structures. These CHIPS integrate with a vascular and perfusion organ-on-a-chip reactor, creating a complete tissue engineering platform that closely simulates a real cellular environment.

In collaboration with Adam Feinberg, a professor of biomedical engineering at Carnegie Mellon University, Shiwarski's team published their findings in the April edition of Science Advances, where the study, titled "3D Bioprinting of collagen-based high resolution internally perfusable scaffolds for engineering fully biologic tissue systems," was featured as the cover story.

Revolutionizing Disease Modeling With Natural Materials

Shiwarski's research leverages additive manufacturing and tissue engineering to create functional replacement tissues and model diseases like diabetes and hypertension. A popular method of studying these diseases in vitro, microfluidic modeling, uses tiny channels in a small chip to simulate blood vessel or cellular behavior. These models are typically made from silicone, and while useful, their synthetic nature has restricted scientists from utilizing these models to their full potential—until now.

"Microfluidic devices help us study cell behavior, but they're inherently limited," Shiwarski said. "Our collagen-based scaffolds change that. Since cells naturally thrive in collagen, we can print not only the structural network but also embed cells directly into that environment, allowing them to grow, interact, and form tissues."

Real Tissue Formation: Cells Thriving in Collagen Networks

Unlike traditionally synthetic microfluidic devices, these printed scaffolds were built entirely from collagen, allowing cells to interact with the model itself by growing and self-organizing into functional tissues within it. The team demonstrated this by combining the collagen with vascular and pancreatic cells, prompting insulin secretion in response to glucose, which mirrored natural physiological function.

To support the growth and development of cellularized collagen scaffolds, the team engineered a custom perfusion bioreactor system, VAPOR.

”This platform is unique as it securely connects the soft collagen-based tissue scaffolds to the VAPOR fluidic system by snapping the CHIPS into place around like Lego blocks,” said Andrew Hudson, co-founder of FluidForm Bio and publication co-author.

Breaking New Ground With 3D Vascular Networks

Additionally, while traditional microfluidic devices are limited in design to flat or sequentially layered patterns, the team also demonstrated the ability to create non-planar 3D networks in soft, organic material by printing helical vascular networks modeled after DNA structure.

“We’re taking everything that works well in microfluidics—like controlling fluid flow and setting up vascular networks—and combining it with natural biomaterials and the innate programming of cells,” Shiwarski said. “If we place cells in an environment that mimics their natural surroundings, they know exactly what to do. We’re recreating the right environment for them and letting the cells do their job, allowing them to adapt, evolve, and build functional tissue over time.”

Future Frontiers: Modeling Disease Without Animal Testing

Shiwarski is also committed to open science with his team’s work; all models and designs from the project are freely available on his lab’s website. Looking ahead, Shiwarski’s team aims to use this platform to study vascular diseases such as hypertension and fibrosis, modeling how these conditions affect tissue development and function. The ultimate goal is to eventually replace animal models with more accurate, human-based systems.

“This new approach lets us bridge the gap between simplified 2D models and animal studies,” Shiwarski said. “Now that we’ve established this functional tissue environment, one of our next big goals is to study how vascular networks form alongside the development of underlying tissues —and how these processes are affected by human-specific disease variants. We can use this as a way to study complicated diseases and understand the basic biology behind them, and then we can get further insight into clinical therapies.”

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