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DRDO News

TARA: India's silent precision that strikes fear in hearts of Pakistan, China, Bangladesh from Afar

Source: [India.com](https://www.india.com), Dt. 01 Apr 2025,

URL: <https://www.india.com/news/world/tara-indias-silent-precision-that-strikes-fear-from-afar-7724603/>

The TARA system is a new smart bomb developed by the DRDO, falling under a category known as glide bombs. These are unique weapons that do not have engines—instead, they glide through the air after being released from an aircraft. Thanks to their aerodynamic shape and built-in wings, glide bombs can travel long distances toward their targets.

What makes the TARA system special is its advanced guidance system, which ensures the bomb stays on course throughout its flight. The primary goal is to equip the Indian Air Force with powerful, precise, and cost-effective weapons that can be used across a variety of combat scenarios.

In short, glide bombs like TARA offer a smart, engine-free solution that combines range, accuracy, and affordability.

TARA is being made to work with different types of Indian Air Force aircraft. It will come in three weight options: 250 kg (TARA 250), 450 kg (TARA 450), and 500 kg (TARA 500). This allows the Air Force to choose the right bomb size based on the mission.

These different versions of the TARA bomb smartly make use of the outer shells (casings) from older bombs already made by DRDO — like the General Purpose (GP) and High-Speed Low Drag (HSLD) bombs. These older bombs are already in use by major Indian Air Force fighter jets such as the Jaguar, Mirage 2000, and Sukhoi Su-30 MKI.

By reusing these existing parts, the new bombs can be made faster and more easily. It also means there's no need for completely new systems, which helps save time, money, and makes storage and transport simpler for the military.

What makes the TARA system special is its advanced control and guidance features. It has small moving parts called fins at the back, which help steer the bomb while it's flying. These fins adjust its direction, making sure the bomb stays on the right path and hits the target accurately. This smart design helps the bomb glide smoothly through the air and reach its goal with high precision.

Thanks to these moving fins, the TARA bomb can make quick turns and adjust its path just before hitting the target. This helps it come in at the best angle to do the most damage. Even if the enemy uses defenses to block or confuse it, the bomb can still stay on track and hit the target with high accuracy. This makes it much more effective in real combat situations.

The speed of the TARA bomb depends on how high and how fast the aircraft is flying when it drops it. It can travel at speeds between around 640 to 1,200 kilometers per hour. This means it can

be used in different types of missions — whether it needs to be dropped quickly at high speed or glide more slowly and carefully toward the target. This flexibility makes it useful in many combat situations.

TARA uses a smart guidance system to make sure it hits its target accurately. During the middle part of its flight, it uses two main tools: an Inertial Navigation System (INS), which tracks its position using internal sensors, and GPS signals, just like the ones used in mobile phones for location. By combining both, TARA can stay on the right path and reach the target with high precision. In fact, it can get so close that it usually lands within 30 meters of the target, which is very accurate for a bomb.

CEP, or Circular Error Probable, is a way to measure how accurate a weapon is. It tells us the area within which half of the bombs are expected to land. For example, if the CEP is 30 meters, it means that out of all the bombs dropped, half will land within 30 meters of the target.

In the final few seconds before TARA hits its target, it switches to a laser-based system called a Semi-Active Laser (SAL) seeker. This system follows a laser beam pointed at the target, allowing the bomb to adjust its path and strike with even more accuracy. With this laser guidance, TARA can hit within just 3 meters of the target, making it extremely precise.

This high level of accuracy puts TARA in the same league as some of the best-known systems in the world, like the American JDAM (Joint Direct Attack Munition). In simple terms, TARA is just as precise as these advanced bombs used by top militaries, showing that it meets strong international standards for hitting targets accurately.

According to the trusted defense website Defence.in, TARA's two-way guidance system makes it very reliable. Even if GPS signals are blocked or jammed by the enemy, the bomb can still find its way using its backup system. And when laser guidance is used, it can hit very specific targets — even ones that are moving — with great accuracy. This makes it especially useful for taking out important targets during missions.

One of the main benefits of the TARA system is that it can travel a long distance after being dropped. This is possible because of its special shape, which helps it glide smoothly through the air. Thanks to this design, it can reach targets that are much farther away compared to regular bombs that simply fall straight down. This gives it a big advantage in missions, as it allows the aircraft to stay at a safer distance while still hitting the target.

The exact distance TARA can cover is not officially shared, as it's kept secret for security reasons. However, similar bombs used in other countries can fly between 50 to 70 kilometers or even more if they are dropped from the right height. This means the bomb can be released from far away and still reach its target, keeping the aircraft and crew at a safe distance from danger.

This ability to strike from far away is very important because it lets the aircraft drop the bomb without getting too close to enemy defenses. Many enemy air defense systems can only shoot down targets within a certain range. By staying outside that danger zone, the aircraft can safely hit its target without being exposed to enemy missiles or guns.

TARA can also change its path in the final moments before hitting the target. This smart movement helps it avoid enemy defenses that are meant to protect important spots. Because of this, TARA is useful for attacking strong and well-protected places like bunkers, military command centers, and even moving targets like vehicles. This makes it a powerful and flexible weapon in different combat situations.

Right now, the Indian Air Force is testing the TARA system by carrying it on its Jaguar fighter jets, which are called “Shamsher” (meaning Sword) in India. These tests are most likely happening at well-known testing areas like Pokhran or Jaisalmer in Rajasthan. During these trials, the aircraft carries dummy versions of TARA — these are non-explosive models used just for testing — under its wings (attached to hardpoints beneath its wings) to study how the system behaves during flight.

The main purpose of these tests is to carefully check how well the TARA bomb works with the Jaguar aircraft. This includes making sure it connects properly with the plane’s electronic systems (also called avionics), testing how safely and smoothly it can be released from the aircraft, and studying how it behaves in the air while being carried. All these checks are important to ensure the bomb works perfectly when used in real missions.

The Jaguar is a trusted fighter jet that has been used for many years. It is known for flying very close to the ground and for carrying heavy weapons. These features make it a great choice for testing advanced weapons like TARA, as it can handle tough missions and help check how well the new system performs in real conditions.

In this testing phase, experts from DRDO and the Indian Air Force, including test pilots and engineers, are closely checking how well the TARA bomb holds up during flight. They are also studying how it affects the way the aircraft flies and making sure it communicates smoothly with the Jaguar’s onboard systems. This includes working with the targeting pod—most likely the Litening pod, which the Air Force often uses to guide bombs using laser targeting. All of this helps ensure that TARA works safely and accurately when used in real missions.

Finishing these current trials is an important step before moving on to the next phase, which is live drop testing. In the upcoming tests, real TARA bombs (with working parts and explosives) will be dropped to check how well the guidance system works. These tests will also help confirm how accurately the bomb can hit its target, whether it’s a real or practice one. This stage is key to proving that TARA can perform well in actual combat situations.

The Jaguar fighter jets have been upgraded with modern technology, including the DARIN II navigation and attack system. This upgrade makes the aircraft more advanced and better equipped to handle smart weapons like the TARA bomb. Thanks to these improvements, the Jaguar can now carry out more precise and high-tech missions.

The TARA bomb is designed in a flexible, modular way, which means it can be used for different types of missions depending on the need. The smaller version, called TARA 250, is lighter and perfect for hitting smaller or less protected targets like enemy vehicles or radar stations. On the other hand, the bigger versions—TARA 450 and TARA 500—are much more powerful. These are used to destroy stronger and more important targets, such as big bridges or underground enemy bunkers. This flexibility makes TARA useful in a wide range of combat situations.

TARA bombs are designed to work with regular general-purpose (GP) bomb shells that the Indian Air Force already has in storage. This makes it easier and more cost-effective to use. There's also the option to use HSLD (High-Speed Low Drag) bomb bodies, which are shaped in a way that reduces air resistance. This means the bomb can travel farther and hit certain types of targets more effectively, especially those that are tougher or harder to reach.

Once the TARA bomb is fully developed and added to the Indian Air Force's arsenal, it will greatly boost their attack power. It will give the Air Force a smarter and more accurate weapon, helping them hit targets more effectively during missions.

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Defence News

Defence Strategic: National/International

Army Commanders Conference Commences In New Delhi

Source: Press Information Bureau, Dt. 01 Apr 2025,

URL: <https://pib.gov.in/PressReleasePage.aspx?PRID=2117274>

The Army Commanders' Conference is being held in New Delhi from 01 - 04 April, 2025. The conference serves as a platform for senior leadership of the Indian Army officials to review and assess the overall security situation and deliberate on key operational priorities to deal with emerging challenges.

Shri Rajnath Singh, Hon'ble Raksha Mantri will chair the Hon'ble Raksha Mantri Session and will deliver the keynote address. The session will also include a presentation on Indian Army's focus in the 'Year of Reforms'. Senior leadership of the Army will also be addressed by the CDS. The conference will also feature a talk by CEO, NITI Aayog on India's journey and the envisaged role of the armed forces to build a 'Saksham & Sashakt Bharat'.

Aligned to Indian Army's goal of an Agile, Adaptive, Technologically enabled and Future Ready Force, the senior hierarchy will also engage in intense deliberations with experts to usher in new methodologies for effective decision making.

Other issues under deliberation will focus on enhancing the overall organisational health and easing the processes of the Field Army to make them more resilient and responsive. The forum will also discuss issues concerning the welfare and well-being of its personnel aimed at enhancing the quality of life for soldiers and their families.

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Defence exports surge to a record high of Rs 23,622 crore in Financial Year 2024-25, a growth of 12.04% over 2023-24

Source: Press Information Bureau, Dt. 01 Apr 2025,

URL: <https://pib.gov.in/PressReleasePage.aspx?PRID=2117348>

Defence exports have surged to a record high of Rs 23,622 crore (approx. US\$ 2.76 Billion) in the Financial Year (FY) 2024-25. A growth of Rs 2,539 crore or 12.04% has been registered in the just-concluded FY over the defence exports figures of FY 2023-24, which were Rs 21,083 crore.

The Defence Public Sector Undertakings (DPSUs) have shown a significant increase of 42.85% in their exports in the FY 2024-25 reflecting the growing acceptability of Indian products in the global market and the ability of the Indian defence industry to be a part of the global supply chain.

The private sector and DPSUs have contributed Rs 15,233 crore and Rs 8,389 crore respectively in defence exports of 2024-25, whereas the corresponding figures for FY 2023-24 were Rs 15,209 crore and Rs 5,874 crore respectively.

Through a post on X, Raksha Mantri Shri Rajnath Singh congratulated all the stakeholders on achieving the feat. He stated that under the leadership of Prime Minister Shri Narendra Modi, India is marching towards achieving the target of increasing defence exports to Rs 50,000 crore by 2029.

India has evolved from a largely import-dependent military force to the one increasingly focused on self-reliance and indigenous production. In a major boost to defence exports, wide range of items from ammunition, arms, sub-systems/systems and parts & components have been exported to around 80 countries in the just-concluded FY.

The Department of Defence Production has a dedicated portal for application and processing of export authorisation requests, and 1,762 Export Authorisation were issued in FY 2024-25 compared to 1,507 in the preceding year, registering a growth of 16.92%. The total number of exporters also grew by 17.4% in the same period.

Many policy reforms have been brought-in by the Government in the past few years to boost the Indian defence industry such as simplification of industrial licensing procedure, removal of parts and components from license regime, extending the validity period of license etc.

In addition, SOP for grant of Export Authorisation was further simplified, and more provisions were added in the last financial year to boost exports from the country.

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Global demand for explosives, ammunition leads to record defence exports

Source: The Economic Times, Dt. 02 Apr 2025,

URL: <https://economictimes.indiatimes.com/news/defence/global-demand-for-explosives-ammunition-leads-to-record-defence-exports/articleshow/119881445.cms>

A surge in global demand for explosives and ammunition, fed by ongoing conflicts in Europe and West Asia, has resulted in record Indian defence exports, with the figure crossing ₹23,622 crore in 2024-25.

Defence exports, which have been actively promoted by the government over the past decade, grew at over 12%, with strong demand for Indian manufactured explosives like TNT, RDX and HMX in the global market.

Sources said that most Indian explosives and ammunition manufacturing capacity has been fully booked for the next three years, with at least five more plants coming up within the private sector in the coming months.

State-owned defence public sector units have recorded a 42.8% surge in exports, reaching a high of ₹8,389 crore in the financial year. A large part of these too are for explosives and parts for ammunition, particularly for artillery which is in big demand in Europe. Reflecting the growing number of defence manufacturing companies in India, the total number of exporters has also grown by 17.4% in the last year.

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Why India decided to wet lease 60-year-old KC-135 aircraft from US military contractor Metrea for IAF, Navy

Source: The Week, Dt. 01 Apr 2025,

URL: <https://www.theweek.in/news/defence/2025/04/01/why-india-decided-to-wet-lease-60-year-old-kc-135-aircraft-from-us-military-contractor-metrea-for-iaf-navy.html>

A few days ago, the defence ministry signed a contract with US-based military contractor Metrea Management for wet leasing of flight refuelling aircraft (FRA) for providing air-to-air refuelling training to pilots of Indian Air Force (IAF) and Indian Navy.

Wet leasing refers to the leasing arrangement in which one airline offers an aircraft, crew, maintenance and insurance to another airline or entity for a stipulated period.

Metrea will provide FRA Stratotanker refuelling aircraft within six months. This will be the first FRA to be wet leased by IAF.

About KC-135 Stratotanker

A crucial component of the United States Air Force's operational capabilities for over 60 years, KC-135 Stratotanker is a military aerial refuelling aircraft developed by Boeing.

KC-135 is equipped with a flying boom system for refuelling, which allows it to transfer fuel to other aircraft during flight. It can also be fitted with a multipoint refueling system that enables it to refuel two aircraft simultaneously.



Most of the internal fuel could be pumped through boom, which is the aircraft's primary fuel transfer method. The boom operator, who would be stationed near the rear of the aircraft controls the boom during in-flight air refueling.

Besides, the drogue attached to and trailing behind the flying boom could be used for refuelling aircraft fitted with probes. The IAF primarily uses the probe-and-drogue system for aerial refuelling.

Why KC-135?

India is wet leasing a KC-135 Stratotanker in a bid to address the major operational challenges faced by its existing fleet of Soviet/Russian four-engined tanker Ilyushin Il-78MKI tankers, including unreliable refuelling pods, problems with maintenance.

India inducted Ilyushin Il-78MKI refuelling aircraft in 2003. Since its induction, there have been major operational and logistic challenges. The operational readiness and flexibility of the Indian defence forces, especially in the wake of the heightened tensions with China along the Line of Actual Control, suffered due to persistent maintenance and serviceability issues which include a lack of adequate manufacturer support. Over the years, the fleet's availability rates has fallen below 50 per cent, much below IAF's target of 70 per cent.

India's attempts to procure new tankers have been stuck in bureaucratic hurdles, prompting the defence ministry to look for interim solutions. The wet leasing arrangement is seen as a cost-effective and flexible option, allowing for immediate operational deployment.

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भारत की नई परमाणु पनडुब्बी में लगेगी K5 मिसाइल, आधी दुनिया के टारगेट रेंज में

Source: Aaj Tak, Dt. 01 Apr 2025,

URL: <https://www.aajtak.in/defence-news/story/k-5-ballistic-missile-launch-from-s-4-arihant-class-nuclear-powered-submarines-know-its-power-dskc-2205319-2025-04-01>

भविष्य में भारतीय नौसेना की नई अरिहंत-क्लास न्यूक्लियर-पावर्ड बैलिस्टिक मिसाइल सबमरीन S-4 में खतरनाक K-5 मिसाइल लगाई जाएगी। Indian Navy में K Series की कई मिसाइलें तैनात हैं। कुछ पनडुब्बियों में तो कुछ युद्धपोतों में। इस मिसाइल से चीन-पाकिस्तान की हालत खराब हो जाएगी। हिंद महासागर से दागी गई तो ऑस्ट्रेलिया, अफ्रीका, चीन, रूस, मिडिल ईस्ट, यूरोप सब रेंज में आएंगे।

पनडुब्बी से छोड़ी जाने वाली यह मिसाइल 5 से 6 हजार किलोमीटर तक मार कर सकेगी। यानी समंदर में रहकर पूरे देश की सुरक्षा कर पाएगी। अगली मिसाइल जो भारतीय नौसेना की पनडुब्बियों में लग सकती है, वो है K सीरीज की परमाणु बैलिस्टिक मिसाइल K-5। यह सबमरीन लॉन्चड बैलिस्टिक मिसाइल (SLBM) है।

इस मिसाइल को देश में ही डेवलप किया गया है। इसमें 2000 kg वजनी वॉरहेड लगा सकते हैं। वह पारंपरिक हो या फिर परमाणु हो। इसकी रेंज फिलहाल 5 से 6 हजार km बताई जा रही है। लेकिन हल्के वॉरहेड के साथ यह 8 से 9 हजार किलोमीटर तक मार कर सकती है। इसे भारतीय रक्षा एवं विकास संगठन बना रहा है।

अगर इस मिसाइल को भारतीय समुद्री क्षेत्र (Indian Ocean Region – IOR) में मौजूद पनडुब्बी से लॉन्च किया जाए तो चीन और पाकिस्तान के कई प्रमुख शहर किसी भी मिनट खत्म हो सकते हैं। इसे फिलहाल अरिहंत क्लास सबमरीन और एस-5 क्लास सबमरीन में लगाया गया है। भविष्य में बाकी पनडुब्बियों में भी लगाया जा सकता है।

कई टारगेट पर हमला भी कर सकेगी

K-5 बैलिस्टिक मिसाइल में राडार को धोखा देने की तकनीक और काउंटरमेजर्स भी लगाए जाने की उम्मीद है, ताकि दुश्मन को यह पता ही न चले कि मिसाइल कब और कहां से आ रही है। इसके अलावा इसमें MIRV तकनीक भी लगाई जा सकती है, ताकि एक ही बार में कई जगहों पर निशाना लगाया जा सके।

फिलहाल K-4 सीरीज की मिसाइलें

भारत के पास फिलहाल K-4 सबमरीन लॉन्चड बैलिस्टिक मिसाइलों का जखीरा है। जिनकी रेंज 750 से 3500 km है। लेकिन जब नौसेना नई पनडुब्बियां बना रही है, तो उसे नई मिसाइलों की भी जरूरत होगी। ऐसे में K-5 और K-6 SLBM मिसाइलों की जरूरत है। ताकि ज्यादा रेंज तक हमला किया जा सके।

इसके अलावा Agni-5 सीरीज की SLBM इस्तेमाल की जा सकती है। अग्नि-5 मिसाइल की ताकत को पूरी दुनिया जानती है। साथ ही चीन और पाकिस्तान तो खौफ खाते हैं। क्योंकि इसकी रेंज में पूरा पाकिस्तान और आधा चीन आता है। लेकिन के-सीरीज की एडवांस मिसाइलों को शामिल किया जा सकता है।

अग्नि-5 SLBM की ताकत

यह एक अंतरमहाद्वीपीय परमाणु बैलिस्टिक मिसाइल है। जिसकी रेंज 7 से 8 हजार किलोमीटर है। इसमें एक साथ कई वॉरहेड लगा सकते हैं। यानी यह MIRV तकनीक से लैस है। एक ही मिसाइल से पांच टारगेट्स को हिट किया

जा सकता है. इसमें 400 किलोग्राम वजनी परमाणु या पारंपरिक हथियार लगा सकते हैं. इसकी अधिकतम गति 30 हजार किलोमीटर प्रतिघंटा से ज्यादा है.



K-6 मिसाइल भी दमदार

यह मिसाइल अभी बनाई जा रही है. 39 फीट लंबी इस मिसाइल में 3 हजार किलोग्राम वजनी परमाणु हथियार लगा सकते हैं. इससे कई टारगेट्स पर निशाना लगाया जा सकता है. इसकी रेंज 8 से 12 हजार किलोमीटर होगी. इसे एस-5 सबमरीन में लगाने की योजना है.

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From Boots To BrahMos — India’s Defense Production Up By 174%, Exports Shoot 30 Times; What Next For India?

Source: The EurAsian Times, Dt. 02 Apr 2025,

URL: <https://www.eurasiantimes.com/indias-defense-production-up-174-defens/>

India’s defense production has reached Rs 1.27 lakh crore in FY 2023-24, marking a 174% rise since 2014-15 when the ‘Make in India’ initiative was launched. At the same time, defense exports have also risen to a record high of Rs 21,083 crore, expanding 30 times in one decade.

Presently, Indian defense exports are reaching more than 100 countries. This signifies the resilience of the Indian defense industry and sustained efforts in policy implementation. India has traditionally been an importer of defense equipment. Even the recent SIPRI report placed India as the number two arms importer, behind Ukraine. This is, however, likely to change as the contribution of the private defense industry increases.

The domestic industry manufactures fighter aircraft, ships, submarines, main battle tanks, unmanned aerial vehicles, helicopters, artillery systems, and missiles. Recent orders for 156 Light

Combat Helicopters (LCH), Advanced Towed Artillery Gun System (ATAGS), and NAG missile systems will further consolidate the position and credibility of domestic manufacturers.

The defense budget for FY 2025-26 has earmarked Rs 1,11,544 crores for procurement from domestic industry out of Rs 1,48,722 crores allocated for capital acquisitions. As much as 25% of the domestic industry allocation is earmarked for procurements from private industry, highlighting the government's commitment to promoting the private defense industry. This is also likely to provide impetus to the private industry to invest more in R&D, which is currently lacking. A larger share of indigenous products in the Indian armed forces would enhance export avenues.

Growth Of The Indian Defense Industry

The domestic defense industry in India has grown substantially. This is a result of the government's encouragement to source more from private industry and the entry of bigger industry players like Tatas, L&T, Adani, Reliance, Mahindra, Bharat Forge, and many more into defense manufacturing. Another factor has been their collaborations with foreign OEMs in joint ventures, which have helped the industry absorb technology and manufacturing.

Similarly, the PSUs have expanded their portfolios and are now sourcing more from MSMEs. The establishment of defense corridors in Uttar Pradesh and Tamil Nadu has also helped the cause. Another factor in this growth has been the offset contracts associated with imports of defense equipment. About US\$4.7 billion worth of offset contracts have been signed since 2007. This has provided much-needed impetus to domestic private industry, especially in the aerospace sector.

India imported almost 70% of its defense equipment in the early 2000s, but the incredible turnaround under Make in India has led to 65% of defense equipment being manufactured domestically. From 16 PSUs that held the monopoly of producing or assembling defense equipment, today, there are more than 430 licensed companies and over 16,000 MSMEs. Indian tech startups (around 194) in this field have also added value through innovation and collaboration with foreign partners in providing efficient, economical, and technologically advanced solutions.

Innovation for Defense Excellence (iDEX) has provided additional impetus, under which Rs 449.62 crore has been allocated for developing innovative technologies. Acing Development of Innovative Technologies with iDEX (ADITI) was launched recently to support critical and strategic technologies such as satellite communication, advanced cyber technology, autonomous weapons, semiconductors, artificial intelligence, quantum technology, nuclear technologies, and underwater surveillance. Under this scheme, grants of up to Rs 25 crore are provided to innovators.

The Self-Reliant Initiatives through Joint Action (SRIJAN) portal was launched to provide definitive guidance on the indigenization of imported items. The website hosted a list of 38,000 such items, of which 14,000 have been successfully indigenised. The major hurdle in this endeavor has been the delays in the certification of locally developed components and spares by MSMEs. The progress in exports is also encouraging. Defense exports have witnessed excellent growth over the last decade, growing 21 times from Rs 4,213 crore in 2004-2014 to Rs 88,319 crore in the 2014-24 time period.

The portfolio has diversified to include items from Boots to the Brahmos missile system. Major equipment being exported includes bulletproof jackets, Dornier-228 transport aircraft, Chetak

helicopters, the Brahmos missile system, the Akash Missile System, fast interceptor boats, and lightweight torpedoes. The government has set an export goal of Rs 50,000 crore (\$6B) by 2029. This would require diversifying the export portfolio to higher-value items.

Future of Defense Exports

The market for defense exports from India comprises developing countries, including some in West Asia. Recent conflicts are indicators of future wars. Space, Cyber, and Electronic Warfare will play a significant role in operations. AI, autonomy, robotics, and quantum technologies will impact all future operations. The industry needs to focus on these fields to compete with others for exports.

Progress made in drone and counter-drone technologies, radars, electronic warfare equipment, helicopters, weapons, missile systems (air-to-air, surface-to-air, surface-to-surface), and fighters like LCA Mk1, and MkII opens up export opportunities. ALH has not been a great success story, with more than 330 helicopters grounded for the umpteenth time since January 25. Light Utility Helicopter (LUH) and Light Combat Helicopter (LCH) should not suffer the same fate, and necessary corrective actions should be implemented to succeed in the export market.

India's biggest advantage of being viewed as a friendly nation must be leveraged, along with the competitive cost of platforms and equipment. Additionally, we could collaborate with like-minded nations within Asia to produce future systems and expand our reach. Defense equipment is technology-intensive and, hence, sensitive to technological change. The defense industry must, therefore, be able to match the world's technological evolution. It must also be cost-effective in a highly competitive market.

Growing Chinese exports serve as an example, especially for exploring opportunities in Asia, Africa, and South America. An agency to identify futuristic technologies and guide their development must be established.

Way Forward

India needs to continuously explore and map potential export opportunities. To this end, a cell in the MoD with representation from the three services/ HQ IDS, and MEA should be created to work with the defense industry in identifying export opportunities. Scan current technologies and those of the future. If the Advanced Medium Combat Aircraft (AMCA) is produced by 2035, it will be the last fifth-generation fighter in the world.

By then, countries would have captured the market ahead of India. Similarly, the export opportunities for LCA Mk2 and its export configuration should be finalized during the development process. Shortlist successful ventures and products like ground-based radars, airborne radars, air-to-air missiles like ASTRA, air-to-ground weapons like SAAW, and range extension kits for air-to-ground bombs for export. The private defense industry is producing a wide variety of UAVs, including loitering munitions, which could also be leveraged for export.

India should target developing countries, and where required, exports could be facilitated by extending a line of credit specifically for defense equipment. There have been both successes and failures in this area. These need to be reviewed and refined to enhance the success rate. Establish a

help desk to assist startups and MSMEs in connecting with defense majors and OEMs abroad, enhancing their visibility and reach in foreign markets. This could be showcased through the Indian embassies in selected countries.

Review approval processes for export and make them flexible, easy, and efficient to ensure ease of export. Integration of imported components like engines and electronics is a potential showstopper for export due to diplomatic issues or export clearances for these items. The products would be more acceptable if they were completely indigenous with minimal import content, especially of critical components. Ukraine has pioneered innovations in drones during the ongoing war with Russia. These innovations could be leveraged to kick-start an entirely new drone ecosystem in India with expertise from Ukraine's industries. Acquisitions or collaborations are two options.

Conclusion

Indian defense industry has witnessed remarkable growth in the last decade. From being an import-dependent country, the landscape has reversed, with 65% domestic production. India is now exporting contemporary defense equipment to more than 100 countries, including the USA and France. With modern equipment like fighter aircraft, helicopters, main battle tanks, artillery systems, surface-to-air missiles, aircraft carriers, and other ships being manufactured in India, it is now time to achieve parity with nations currently exporting major defense equipment.

Leverage cost and engineering talent advantage (a large number of global capability centers are located in India). Compress the time from development to production to be competitive in a time-sensitive market. A focused approach is needed to capture the defense market for Indian products like fighter aircraft, helicopters, ships, weapons, and land systems. Increasing presence and outreach would pay rich dividends in this regard. It is imperative that our technology development and deployment are executed in a time-bound manner to send the right signal to potential buyers. A proactive approach is hence the need of the hour to achieve export targets.

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Science & Technology News

ISRO achieves breakthrough in now-casting of lightning events by using data from INSAT-3D satellite

Source: The Hindu, Dt. 01 Apr 2025,

URL: <https://www.thehindu.com/news/cities/bangalore/isro-achieves-breakthrough-in-now-casting-of-lightning-events-by-using-data-from-insat-3d-satellite/article69400633.ece>

ISRO's National Remote Sensing Centre (NRSC) has achieved a breakthrough in the now-casting of the lightning events over India using data from Indian geostationary satellites. According to ISRO, atmospheric lightning occurs due to the complex interactions of meteorological parameters under the influence of convective processes in the troposphere.

Key drivers of these convective phenomena include surface radiation, temperature, and wind.

“Lightning now-casting assumes importance as lightning is a dominant natural hazard over the tropics. NRSC/ISRO researchers observed lightning signatures in the Outgoing Longwave Radiation (OLR) data from the INSAT-3D satellite. The reduction in OLR strength is an indicator for potential lightning occurrences,” ISRO said.

It added that the near real-time observations from the INSAT series satellites were utilised to detect and identify signatures indicative of lightning occurrences.

To further enhance the detection of lightning activity, additional parameters such as Land Surface Temperature (LST) and wind were incorporated in the development of a composite variable to improve predictive accuracy.

“The developed composite variable effectively captures the variations in lightning activity observed by ground-based measurements. It provides a reliable indication of when lightning activity is likely to peak or subside, allowing for improved prediction of lightning occurrence and intensity. This composite variable enables the prediction of lightning occurrences with a lead time of approximately 2.5 hours,” ISRO said.

According to IMD, now-casting refers to a weather forecast in which the details about the current weather and forecasts up to a few hours ahead (but less than 24 hours) are given.

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IISc. researchers develop bacteria-based technique to repair space bricks in lunar habitats

Source: The Hindu, Dt. 01 Apr 2025,

URL: <https://www.thehindu.com/sci-tech/science/iisc-researchers-develop-bacteria-based-technique-to-repair-space-bricks-in-lunar-habitats/article69399623.ece>

Researchers at the Indian Institute of Science (IISc.) have developed a bacteria-based technique to repair bricks that can be used to build lunar habitats, if they get damaged in the moon’s harsh environment. According to IISc., future lunar expeditions are no longer planned as just flyby missions. NASA’s Artemis programme, for example, seeks to set up a permanent habitat on the moon.

To cut costs, instead of carrying material from Earth, astronauts would need to use the abundantly available lunar soil, or ‘regolith’ – a complex mixture of broken minerals and rocks – to build structures on site.

A few years ago, researchers at the Department of Mechanical Engineering (ME), IISc., developed a technique that uses a soil bacterium called *sporosarcina pasteurii* to build bricks out of lunar and Martian soil simulants.

Calcium carbonate crystalsThe bacterium converts urea and calcium into calcium carbonate crystals that, along with guar gum, glue the soil particles together to create brick-like materials. This process is an eco-friendly and low-cost alternative to using cement.

Subsequently, the team also explored sintering – heating a compacted mixture of soil simulant and a polymer called polyvinyl alcohol to very high temperatures – to create much stronger bricks.

“It’s one of the classical ways of making bricks. It makes bricks of very high strength, more than adequate even for regular housing,” said Alope Kumar, Associate Professor in the Department of ME and corresponding author of the study.

IISc said that though sintering is an easily scalable process, as multiple bricks can be made at once in a furnace, the lunar surface is extremely harsh (temperatures can swing from 121°C to -133°C in a single day), and it is constantly bombarded by solar winds and meteorites.

This can cause cracks in these bricks, weakening structures built using them.

Temperature changes

“Temperature changes can be much more dramatic on the lunar surface, which can, over a period of time, have a significant effect. Sintered bricks are brittle. If you have a crack and it grows, the entire structure can quickly fall apart,” said co-author Koushik Viswanathan, Associate Professor.

To solve this problem, the team once again turned to bacteria. In a new study, they created different types of artificial defects in sintered bricks and poured a slurry made from *sporosarcina pasteurii*, guar gum, and lunar soil simulant into them.

“We were initially not sure if the bacteria would bind to the sintered brick. But we found that the bacteria can not only solidify the slurry, but also adhere well to this other mass,” Prof. Kumar said.

Tolerance to high temperatures

The reinforced bricks were able to withstand temperatures ranging from 100°C to 175°C. The team is currently working on a proposal to dispatch a sample of *sporosarcina pasteurii* into space as part of the Gaganyaan mission, to test its growth and behaviour under microgravity.

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Jaishankar, Dutch counterpart discuss coop in new technologies

Source: The Tribune, Dt. 02 Apr 2025,

URL: <https://www.tribuneindia.com/news/india/jaishankar-dutch-counterpart-discuss-coop-in-new-technologies/>

India and the Netherlands are deepening cooperation in emerging technologies, particularly semiconductors and green hydrogen, while also facilitating skilled Indian professionals to work in the Netherlands, Dutch Foreign Minister Caspar Veldkamp said on Tuesday.

During a bilateral meeting, External Affairs Minister S Jaishankar and his Dutch counterpart Veldkamp discussed technology as a key area of collaboration. The two countries have engaged in three rounds of talks on semiconductors over the past year, driven by the Netherlands-based ASML, a global leader in semiconductor manufacturing equipment. India, aiming to develop its

own chip-making capabilities for military and space applications, sees the Netherlands as a crucial partner in this effort.

In December, Dutch Prime Minister Dick Schoof and Prime Minister Narendra Modi agreed to elevate bilateral ties, with a focus on defence, semiconductors and green hydrogen. This was further reinforced in February when Defence Minister Rajnath Singh and his Dutch counterpart Kajsa Ollongren highlighted cooperation in semiconductors and clean energy.

Jaishankar and Veldkamp also discussed migration, mobility and youth exchanges. Veldkamp, on his first official visit to India (March 31-April 1), also met National Security Adviser Ajit Doval.

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Plastic Supercapacitors Could Help Solve the Energy Crisis

Source: SciTech Daily, Dt. 01 Apr 2025,

URL: <https://scitechdaily.com/plastic-supercapacitors-could-help-solve-the-energy-crisis/>

Plastics have shaped our modern world and transformed the way we live. For decades, they were primarily used in electronics for their excellent insulating properties. However, in the 1970s, scientists accidentally discovered that some plastics can also conduct electricity. This breakthrough revolutionized the field and paved the way for new applications in electronics and energy storage.

One of the most widely used electrically conductive plastics today is poly(3,4-ethylenedioxythiophene), commonly known as PEDOT. This material forms a flexible, transparent film that is often applied to surfaces such as photographic films and electronic components to prevent static buildup. PEDOT is also used in touchscreens, organic solar cells, and electrochromic devices, like smart windows that change transparency with the push of a button.

Despite its many applications, PEDOT's use in energy storage has been limited. Commercial forms of PEDOT typically have low electrical conductivity and limited surface area, which restrict their ability to store significant amounts of energy.

UCLA chemists are addressing these challenges with an innovative method to control the morphology of PEDOT to grow nanofibers precisely. These nanofibers exhibit exceptional conductivity and expanded surface area, both of which are crucial for enhancing the energy storage capabilities of PEDOT. This approach, described in a paper published in *Advanced Functional Materials*, demonstrates the potential of PEDOT nanofibers for supercapacitor applications.

Supercapacitors vs. Batteries

Unlike batteries, which store energy through slow chemical reactions, supercapacitors store and release energy by accumulating electrical charge on their surface. This allows them to charge and discharge extremely quickly, making them ideal for applications requiring rapid bursts of power, such as regenerative braking systems in hybrid and electric vehicles and camera flashes. Better supercapacitors are, therefore, one route to reduced dependence on fossil fuels.

The challenge with supercapacitors, however, is creating materials with enough surface area to hold large amounts of energy. Traditional PEDOT materials fall short in this regard, which limits their performance.

The UCLA chemists produced the new material through a unique vapor-phase growth process to create vertical PEDOT nanofibers. These nanofibers, resembling dense grass growing upward, dramatically increase the material's surface area, allowing it to store more energy. By adding a drop of liquid containing graphene oxide nanoflakes and ferric chloride on a graphite sheet, the researchers exposed this sample to a vapor of the precursor molecules that eventually formed the PEDOT polymer. Instead of developing into a very thin, flat film, the polymer grew into a thick, fur-like structure, significantly increasing the surface area compared to conventional PEDOT materials.

Exceptional Energy Storage Capabilities

“The material's unique vertical growth allows us to create PEDOT electrodes that store far more energy than traditional PEDOT,” said corresponding author and UCLA materials scientist Maher El-Kady. “Electric charge is stored on the surface of the material, and traditional PEDOT films don't have enough surface area to hold very much charge. We increased the surface area of PEDOT and thereby increased its capacity enough to build a supercapacitor.”

The authors used these PEDOT structures to fabricate supercapacitors with excellent charge storage capacity and extraordinary cycling stability, reaching nearly 100,000 cycles. The advance could pave the way for more efficient energy storage systems, directly addressing global challenges in renewable energy and sustainability.

“A polymer is essentially a long chain of molecules built out of shorter blocks called monomers,” said El-Kady. “Think of it like a necklace made from individual beads strung together. We heat the liquid form of the monomers inside a chamber. As the vapors rise, they react chemically when they come in contact with the surface of the graphene nanoflakes. This reaction causes the monomers to bond and form vertical nanofibers. These nanofibers have (a) much higher surface area, which means they can store much more energy.”

Record-Breaking Results and Durability

The new PEDOT material has shown impressive results, exceeding expectations in several critical areas. Its conductivity is 100 times higher than that of commercial PEDOT products, making it far more efficient for charge storage. What's even more remarkable is that the electrochemically active surface area of these PEDOT nanofibers is four times greater than that of traditional PEDOT. This increased surface area is crucial because it allows for much more energy to be stored in the same volume of material, significantly boosting the performance of supercapacitors.

Thanks to the new process, which grows a thick layer of nanofibers on the graphene sheet, this material now has one of the highest charge storage capacities for PEDOT reported to date — more than 4600 milliFarads per square centimeter, which is nearly one order of magnitude higher than conventional PEDOT. On top of that, the material is incredibly durable, lasting through more than 70,000 charging cycles, far outlasting traditional materials. These advances open the door for

supercapacitors that are not only faster and more efficient but also longer-lasting, which are essential qualities for the renewable energy industry.

“The exceptional performance and durability of our electrodes shows great potential for graphene PEDOT’s use in supercapacitors that can help our society meet our energy needs,” said corresponding author Richard Kaner, a UCLA distinguished professor of chemistry and of materials science and engineering, whose research team has been at the forefront of conducting polymer research for over 37 years. As a doctoral student, Kaner contributed to the discovery of electrically conductive plastic by his advisors Alan MacDiarmid and Alan Heeger, who later received a Nobel Prize for their work.

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