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# समाचार पत्रों से चयित अंश Newspapers Clippings

A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence Technologies, Defence Policies, International Relations and Science & Technology

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## Army successfully launches BrahMos supersonic cruise missile

*The missile can reach the speed of 2.8 times that of sound. The launch by the Army comes over a month after the Naval version of the BrahMos missile was successfully test-fired from INS Chennai*

Pune: The Indian Army on Tuesday successfully launched BrahMos, a supersonic land attack cruise missile, at Car Nicobar Islands in a “top-attack” configuration, hitting a target in Bay Bengal. The launch is said to be the first in a series of various versions of the missile in the coming days, in a display of India’s tactical cruise missile triad.

The test by the Army comes over a month after the naval version of BrahMos was successfully test fired from Indian Navy’s indigenously-built stealth destroyer INS Chennai, hitting a target in the Arabian Sea.

Posting a video of the test, the Pune-headquartered Southern Command of the Indian Army tweeted, “Indian Army successfully launched its BrahMos supersonic cruise missile on November 24 in a top-attack configuration, hitting a target in the Bay of Bengal with pin point accuracy.”

Most modern missiles, including BrahMos, can be fired in both top-attack and direct attack modes. In top attack mode, the missile is required to climb sharply after launch, travel at a certain altitude and then plunge on top of the target. In direct attack mode, the missile travels at a lower altitude, directly striking the target. The test was conducted from Andaman and Nicobar archipelagos. Officials said more tests of the supersonic cruise missile are slated to be conducted by the Navy and the Indian Air Force in the coming days. These tests are a display of India’s tactical cruise missile triad — launch capability from land, sea and air platforms, they added.

While versions of the BrahMos missile have been in India’s arsenal for long, the weapon system is continuously tested for examining its hardware and software systems. In every such test of a



The BrahMos supersonic cruise missile was launched in a top-attack configuration on November 24.



The test was conducted from the Andaman and Nicobar archipelago, hitting a target in the Bay of Bengal.

specific variant of the BrahMos, different parameters are put to examination. The present supersonic version can reach a speed of 2.8 times that of sound (2.8 Mach). A hypersonic version of the missile, capable of reaching a speed of 5 Mach, is under development.

An amalgamation of the names of Brahmaputra and Moskva rivers, BrahMos missiles are designed, developed and produced by BrahMos Aerospace, a joint venture company set up by the Defence Research and Development Organisation (DRDO) and Mashinostroyeniya of Russia. Various versions of BrahMos, including those that can be fired from land, warships, submarines and Sukhoi-30 fighter jets, have already been developed and successfully tested in the past.

A press statement from the Army said, “On November 24, approximately 1003 hours IST, the Indian Army successfully test fired a BrahMos Land Attack Cruise Missile using a Mobile Autonomous Launcher (MAL) from Car Nicobar Islands, against a designated target located at a range of approximately 200 kilometers in the Bay of Bengal. During this successful test launch, the missile demonstrated the weapon’s unmatched lethal ability and formidable precision strike capability.”

The release added, “The land attack version of BrahMos, with capability of cruising at 2.8 Mach speed, is the cutting edge of the Indian Army since 2007. The present Block III version of the missile has successfully executed four operational launches in the past. With the upgraded capability, the missile can hit targets at a range of up to 400 kilometer with precision. The launch marks the achievement of a critical milestone in enhancing India’s capability of engaging enemy’s vitally important targets in depth areas. The launch was witnessed by various dignitaries who lauded the commendable effort demonstrated during the successful execution of the launch.”

<https://indianexpress.com/article/india/army-successfully-launches-brahmos-supersonic-cruise-missile-7063865/>

## THE TIMES OF INDIA

Wed, 25 Nov 2020

### India kicks off multiple 'live tests' of BrahMos supersonic cruise missile

*By Rajat Pandit*

New Delhi: India on Tuesday kicked off what will be multiple operational firings of the BrahMos supersonic cruise missile this week, in yet another hard-nosed display of its precision-strike capabilities amidst the ongoing military confrontation with China in eastern Ladakh.

The first “live missile test” of the 290-km range BrahMos, which is a deadly conventional (non-nuclear) weapon that flies almost three times the speed of sound at Mach 2.8, was conducted by the Army in the Andaman and Nicobar archipelago at about 10 am on Tuesday.

Similar tests will be carried out by the Navy and IAF also in the Indian Ocean Region this week. “The requisite advance warnings to aircraft and ships in the Arabian Sea and Bay of Bengal have been issued,” said a defence ministry source.

The tests come even as BrahMos land-attack missile batteries have already been deployed in Ladakh and Arunachal Pradesh, along with tanks, howitzers, surface-to-air missiles and other weapons, as part of the overall military readiness



posture against China. Similarly, some Sukhoi-30MKI fighters armed with BrahMos missiles are also deployed in airbases closer to the Line of Actual Control.

Sources say work is also underway to make the enhanced version of BrahMos with a strike range of almost 450-km, which has been successfully tested three to four times, operational as soon as possible. Moreover, India and Russia are also getting set to test a new version of BrahMos, with 800-km range, by middle of next year.

The tests this week will see the Army firing the air-breathing missile at the Trak Island in the Andaman and Nicobar archipelago, while naval warships test the anti-ship variant on the high seas.

The sleeker air-launched version, in turn, will be fired from a Sukhoi flying from the mainland. With a combat radius of almost 1,500-km without mid-air refueling, the Sukhois with BrahMos missiles constitute a formidable long-range weapons package.

“The Sukhoi-BrahMos combination can be used for surgical strikes against underground bunkers, command-and-control centers and other military targets deep inside enemy territory as also warships on the high seas,” said a senior officer.

BrahMos has emerged as the “prime strike weapon” for the armed forces over the years, with contracts worth over Rs 36,000 crore already inked till now. The Army, for instance, has three BrahMos regiments, with another two on the way. Ten frontline warships are also equipped with the BrahMos vertical launch systems, while another two are currently being fitted with them. “Every big warship that goes for refit or upgrade is fitted with the BrahMos missiles now,” said another officer.

The government had earlier also approved the deployment of Block-III version of the BrahMos missiles, which have “steep dive, trajectory manoeuvre, and top-attack capabilities” for mountain warfare in Arunachal Pradesh, as was reported by TOI.

India joining the 34-nation Missile Technology Control Regime (MTCR) in June 2016 has “removed the caps” on the range of the BrahMos missile developed jointly with Russia. The MTCR basically prevents the proliferation of missiles and drones over the range of 300-km.

<https://timesofindia.indiatimes.com/india/india-kicks-off-multiple-live-tests-of-brahmos-supersonic-cruise-missile/articleshow/79380572.cms>

# ThePrint

Wed, 25 Nov 2020

## India now working on 1,500-km range BrahMos supersonic cruise missile

*The Army Tuesday carried out a ‘live missile test’ of the 290-plus km range BrahMos missile, but efforts are on to extend its range to 400, 800 and 1,500 km*

*By Snehash Alex Philip*

New Delhi: India Tuesday began a series of tests of the BrahMos supersonic cruise missile, even as work goes on to extend its range. ThePrint has learnt that India is working on a 1,500-km range version of the system that can be launched from land, water or air.

BrahMos, the only supersonic cruise missile in the world that flies at three times the speed of sound (2.8 Mach), currently has a range of 290 km, but efforts are also on to extend this to 400 km.

The Army carried out the first of several ‘live missile tests’ of the 290-km range BrahMos in the Andaman and Nicobar Islands. The Navy and the Air



BrahMos supersonic cruise missile | File photo: ANI

Force — which has fitted its Sukhoi Su-30 MKI fighters fitted with the BrahMos — are also likely to carry out tests this week.

Sources in the defence and security establishment said the test of the 400-km range of BrahMos conducted in September was successful, and talks are on with the three Services to extend the range of the missiles within a scheduled time period.

A hypersonic version of the missile — which flies at over five times the speed of sound — is also being worked upon, and sources said the target is to test an 800-km range BrahMos next year.

“The team is also working on a 1,500-km range missile,” a source said, adding that initially, this will be a land-based missile.

“But once the system is proven, it will need just some modifications to fire from the air and water,” the source said.

The Indian Air Force had, in January this year, commissioned the 222 ‘Tiger Sharks’ squadron in Thanjavur, home to the first lot of Su-30 MKIs equipped with the BrahMos.

### **Need for speed**

Sources explained that when it comes to the new generation of missiles, speed is a crucial factor.

“The famous example is of the 1998 operation by the US to destroy an Al Qaeda training camp in Afghanistan and to target Osama bin Laden. Tomahawk missiles were fired from the Arabian Sea and took two hours to travel 1,100 miles, as they were traveling at a speed of 550 miles per hour or 0.7 Mach. The missile hit but Osama had left the place an hour back. A faster missile would have meant it would have hit him while he was there,” a source explained.

A missile’s destructive power is enhanced due to large kinetic energy on impact.

### **What is BrahMos?**

The BrahMos missile is the product of a joint venture between India’s Defence Research and Development Organisation and Russia’s NPO Mashinostroyeniya in 1998. It is a portmanteau of the names of two rivers — India’s Brahmaputra and Russia’s Moskva.

The BrahMos missile has a maximum speed of 2.8 Mach (around 3,450 kmph or 2,148 mph), and is difficult to intercept by surface-to-air missiles currently deployed from warships across the world. It also has immense ability to evade various radars.

The missile’s cruising altitude could be up to 15 km, and the lowest it can fly is 10 metres above the surface. The missile is capable of carrying a conventional warhead (non-nuclear) weighing 200-300 kg.

The BrahMos is a two-stage missile, with a solid propellant booster engine that kicks in in the first stage and brings the missile to supersonic speed before separating. Following this, the liquid ramjet comes into action, and takes the missile closer to Mach 3 in cruise phase. It operates on a ‘fire and forget’ principle — it doesn’t have to be constantly monitored on its way to the target.

<https://theprint.in/defence/india-now-working-on-1500-km-range-brahmos-supersonic-cruise-missile/550924/>

# With latest Brahmos launch, India takes another step towards perfecting supersonic cruise missile

*The missile can be used to take out heavily defended enemy targets like airbases, roadways, logistics dumps or army headquarters that may be difficult to reach without risk for India's fighter aircraft*

## Key Highlights

- **Regarded as one of the world's finest supersonic cruise missiles, the BrahMos has a speed of roughly 2.8 Mach (nearly 3,000 kmph) making it incredibly difficult for enemy combatants to target and shoot it down**
- **On September 30, the Army successfully test-fired an extended range variant of the BrahMos that, reportedly, struck a target over 400km away**
- **It is currently used by all three services and can be launched from submarines, surface warship, ground launchers and aircraft**

The Indian Army, on Tuesday, conducted a successful test-firing of the land-attack version of the BrahMos supersonic cruise missile from the Andaman and Nicobar island territory as part of a series of planned launches scheduled for this week. The latest test, and ones expected to follow, come despite the land-attack variant already having been deployed in Ladakh and Arunachal Pradesh along with howitzers, tanks, surface-to-air missiles and other weapons.

Regarded as one of the world's finest supersonic cruise missiles, the BrahMos has a speed of roughly 2.8 Mach (nearly 3,000 kmph) making it incredibly difficult for enemy combatants to target and shoot it down. For perspective, conventional missiles like the US' Tomahawk travel at around 900 kmph – a speed at which supersonic aircraft can overtake them.

On September 30, the Army successfully test-fired an extended range variant of the BrahMos that, reportedly, struck a target over 400km away. The current version of the BrahMos in use is said to have a range of 290 km. Currently, the Indian Army has four BrahMos regiments but it will be years before the extended range version comes into operational service in the 5th and 6th BrahMos regiments.

The real value of the BrahMos missile can be leveraged during opening stages of a conflict. The missile can be used to take out heavily defended enemy targets like airbases, critical roadways, logistics dumps or army headquarters that may be difficult to reach without risk for India's fighter aircraft.

## Decades in the making

The BrahMos project was first implemented in 1998 between India and Russia with both countries originally having to adhere to the Missile Technology Control Regime (MTCR) that prohibits the transfer of missile technology with ranges beyond 300km to non-member states. However, when India became an MTCR member country in 2016, it was no longer bound so strictly to such technology transfer rules.

The medium-range ramjet supersonic cruise missile can be launched from ships, aircraft or land. A joint venture between Russia's NPO Mashinostroyeniya and the DRDO, the missile is,



The BrahMos supersonic cruise missile | Photo Credit: PTI

reportedly, based on the Russian P-800 Oniks cruise missile, and derives its name from the two rivers of Brahmaputra in India and Moskva in Russia.

Since its development, the missile has undergone numerous upgrades, integrated with new hardware and software that has necessitated constant test launches. Over the years, the BrahMos has become one of the most important assets in India's military arsenal. It is currently used by all three services and can be launched from submarines, surface warship, ground launchers and aircraft.

According to reports, each BrahMos regiment - equipped with a mobile entity and command post, four missile-launcher units and several missile carriers capable of carrying up to 90 missiles - costs roughly Rs 2,000 crore. Each BrahMos missile is believed to cost around Rs 15 crore – similar to that of the US military's Tomahawk. As such, despite being among the best supersonic missiles in the world, the prohibitive cost of the missile has found India and Russia struggling to find international buyers for it.

<https://www.timesnownews.com/india/article/with-latest-brahmos-launch-india-takes-another-step-towards-perfecting-supersonic-cruise-missile/685994>

**R. REPUBLICWORLD.COM**

Wed, 25 Nov 2020

## India test-fires BrahMos Supersonic Cruise Missile near Andaman and Nicobar Islands

*India on Tuesday test-fired a land attack version of the BrahMos supersonic cruise missile from the Andaman & Nicobar Island and it has successfully hit its target*

*By Gargi Rohatgi*

India on Tuesday test-fired a land attack version of the BrahMos supersonic cruise missile from Andaman and Nicobar Islands. According to information shared by news agency ANI, the supersonic cruise missile was test-fired at 10 AM and it successfully hit its target, which was on another island. Giving out further details of the land attack, ANI informed that the test was conducted by the Indian Army which has many regiments of the DRDO-developed Missile system and the range of BrahMos missile has now been enhanced to over 400 km.

**The Indian Armed Forces have conducted many successful tests in the last two months:**

**Hypersonic Technology Demonstrator Vehicle (HSTDV):** An unmanned scramjet demonstration aircraft for hypersonic speed flight which can fly at a speed of Mach 6 and move up to an altitude of 32.5 km in 20 seconds, besides its utility for long-range air missiles, the technology can also be used for launching satellites at low cost. It was test-fired on September 7.

**Anti-Tank Guided Missile (ATGM):** ATGM successfully test-fired from an MBT Arjun Tank in Maharashtra's Ahmednagar on September 23. Laser-guided ATGMs lock and track the targets with the help of laser designation to ensure precision hit accuracy.

**BrahMos supersonic cruise missile:** India successfully conducted its second test-fire of the extended range BrahMos supersonic cruise missile on September 30. The test-fire of the missile, which can hit targets at more than 400-km range, was carried out under PJ-10 project of the DRDO.





**Supersonic Missile Assisted Release of Torpedo (SMART):** DRDO conducted successful flight testing of the SMART on October 5, a missile assisted release of lightweight Anti-Submarine Torpedo System for anti-submarine warfare (ASW) operations for far beyond torpedo range.

**RUDRAM:** DRDO on October 9 conducted a successful flight test of an advanced anti-radiation missile. The indigenously developed New generation Anti Radiation Missile or RUDRAM was launched from a SU-30 Mk1 fighter aircraft onto a radiation target located on Wheeler Island off the coast of Odisha.

### **What is BrahMos?**

The BrahMos is a medium-range supersonic cruise missile which can be launched from submarines, ships, aircraft or land. It is the world's fastest supersonic cruise missile, as well as the fastest anti-ship cruise missile in operation. BrahMos-II, a hypersonic version of the missile, is also currently under development. BrahMos Aerospace is a joint venture between DRDO and Russia's NPO Mashinostroyeniya and was established on February 12, 1998. Its name is a combination of India's Brahmaputra and Russia's Moskva rivers.

<https://www.republicworld.com/india-news/general-news/india-test-fires-brahmos-supersonic-cruise-missile-near-andaman-and-nicobar-islands.html>



*Wed, 25 Nov 2020*

## **BrahMos missile test-fired successfully**

Bengaluru: A land-attack version of BrahMos supersonic cruise missile was successfully test-fired from Andaman and Nicobar Islands on Tuesday.

According to sources, today's test was carried out by the Indian Army. The Indian Army has under its command three regiments of BrahMos missile.

During Tuesday's test, the missile is said to have hit a target that was positioned on another island.

More launches of the missile on different modes are lined up this week to test the accuracy of the weapon.

Here's the video via @IaSouthern of #IndianArmy's successful #BrahMos launch today. The missile was in a top-attack configuration, hitting a target in Bay of Bengal with pin point accuracy.

As reported by Onmanorama earlier, scientists at BrahMos Aerospace and Defence Research and Development Organisation have successfully extended the range of the missile from 290 km to over 400 km.

During the DefExpo2020 in February this year, Dr Sudhir Kumar Mishra, CEO & MD of BrahMos Aerospace, had told Onmanorama the missile variants will be tested with an enhanced range this year.

Last month, a BrahMos missile from was successfully tested from Indian Navy's stealth destroyer, INS Chennai. The missile had hit a Battle Practice Target positioned in the Arabian Sea during the launch on October 18.

The air version of the missile was also test-red from a Sukhoi fighter last month, in an extended mission involving multiple Indian Air Force assets. This test was held on October 30.

Prior to that on September 30 this year, a BrahMos missile carrying an indigenous booster and airframe section was successfully flight tested from ITR, Balasore in Odisha.

This launch had paved the way for the serial production of the indigenous booster and other indigenous components of the BrahMos weapon system.

In short, today's launch was the fourth successful mission of BrahMos in just over two months.

“These missions by the users prove the reliability of BrahMos as one of the most potent weapons in modern warfare,” says a scientist.

<https://www.onmanorama.com/news/nation/2020/11/24/brahmos-missile-test-fire.html>

## नवभारत टाइम्स

Wed, 25 Nov 2020

# ब्रह्मोस: जमीन, हवा, पानी... कहीं से भी दुश्मन को तबाह कर सकती है दुनिया की सबसे तेज सुपरसोनिक क्रूज मिसाइल

*ब्रह्मोस दुनिया की सबसे तेज सुपरसोनिक क्रूज मिसाइल है। इसे पनडुब्बी, जंगी जहाज, एयरक्राफ्ट या फिर जमीन से भी लॉन्च किया जा सकता है।*

*By Deepak Verma*

दुनिया की सबसे बड़ी पैदल सेना का दम भरने वाले भारत के पास एक से एक घातक हथियार हैं। हमारी तीनों सेनाओं के बेड़े में ऐसी-ऐसी मिसाइलें हैं दुश्मन को संभलने का मौका तक नहीं देती। जितने वक्त में उनका डिफेंस सिस्टम तैयार हो पाता है, ये मिसाइलें अपना काम निपटा चुकी होती हैं। ब्रह्मोस ऐसी ही एक सुपरसोनिक क्रूज मिसाइल है। 21वीं सदी की सबसे खतरनाक मिसाइलों में से एक, ब्रह्मोस मैच 3.5 यानी 4,300 किलोमीटर प्रतिघंटा की अधिकतम रफ्तार से उड़ सकती है।

सेना ने मंगलवार सुबह 10 बजे अंडमान एंड निकोबार से 290KM रेंज वाली ब्रह्मोस का 'लाइव मिसाइल टेस्ट' किया है। इस हफ्ते ब्रह्मोस मिसाइल के कई ऑपरेशन टेस्ट्स होने हैं। चीन के साथ सीमा पर तनाव के बीच इन टेस्ट्स से यह दिखाने की कोशिश की जाएगी कि मिसाइल कितनी सटीकता से टारगेट हिट कर सकती है। यह मिसाइल रूस और भारत के रक्षा संस्थानों के साथ आने से बनी है। BrahMos में से Brah का मतलब 'ब्रह्मपुत्र' और Mos का मतलब 'मोस्क्वा'। यानी दोनों देशों की एक-एक नदी के नाम से मिलाकर इस मिसाइल का नाम बना है।



ब्रह्मोस: जमीन, हवा, पानी... कहीं से भी दुश्मन को तबाह कर सकती है दुनिया की सबसे तेज सुपरसोनिक क्रूज मिसाइल

### एक नहीं, कई रूपों में आती है ब्रह्मोस मिसाइल

ब्रह्मोस मिसाइल के कई वैरियंट्स हैं। ताजा टेस्ट 290 किलोमीटर रेंज वाली ब्रह्मोस मिसाइल के होने हैं जो कि एक नॉन-न्यूक्लियर मिसाइल है। यह मैच 2.8 की रफ्तार से उड़ती है यानी आवाज की रफ्तार का लगभग तीन गुना। इसे सुखोई लड़ाकू विमान से लॉन्च किया जाएगा। दोनों साथ मिलकर एक घातक कॉम्बो बनाते हैं जिससे दुश्मन कांपते हैं। इस मिसाइल का एक वर्जन 450 किलोमीटर दूर तक वार कर सकता है। इसके अलावा एक और वर्जन टेस्ट हो रहा है जो 800 किलोमीटर की रेंज में टारगेट को हिट कर सकता है।

### हवा, पानी, जमीन... कहीं से भी कर सकते हैं फायर

ब्रह्मोस मिसाइल की खासियत ये है कि इसे कहीं से भी लॉन्च किया जा सकता है। जमीन से हवा में मार करनी वाले सुपरसोनिक मिसाइल 400 किलोमीटर दूर तक टारगेट हिट कर सकती है। पनडुब्बी वाली ब्रह्मोस मिसाइल का पहला टेस्ट 2013 में हुआ था। यह मिसाइल पानी में 40 से 50 मीटर की गहराई से छोड़ी जा सकती है।

ऐसी पनडुब्बियां भी बनाई जा रही हैं जिनमें इस मिसाइल का छोटा रूप एक टारपीडो ट्यूब में फिट किया जाएगा। हवा में मिसाइल छोड़ने के लिए SU-30MKI का खूब इस्तेमाल होता आया है। यह मिसाइल 5 मीटर तक की ऊंचाई पर उड़ सकती है। अधिकतम 14,00 फीट की ऊंचाई तक यह मिसाइल उड़ती है। वैरियंट्स के हिसाब से वारहेड का वजन बदल जाता है। इसमें टू-स्टेज प्रपल्शन सिस्टम है और सुपरसोनिक क्रूज के लिए लिक्विड फ्यूल्ड रैमजेट लगा है।

### **कहां हो सकता है इस्तेमाल?**

सेना के एक वरिष्ठ अधिकारी के मुताबिक, ब्रह्मोस मिसाइल को प्रिसिजन टारगेटिंग के लिए यूज किया जा सकता है। पिछले कुछ सालों में यह सेना के सबसे पसंदीदा हथियार के रूप में उभरी है। सुखोई और ब्रह्मोस का कॉम्बो अंडरग्राउंड बंकर्स, कमांड एंड कंट्रोल सेंटर्स के अलावा कई मिलिट्री टारगेट्स पर सर्जिकल स्ट्राइक करने में इस्तेमाल किया जा सकता है।

### **तीनों सेनाओं में से किसके पास कितनी ब्रह्मोस?**

सेना के किस अंग के पास कितनी ब्रह्मोस मिसाइलें हैं, इसका डेटा सुरक्षा कारणों से सार्वजनिक नहीं किया जाता। भारतीय वायुसेना की स्क्वाड्रन नंबर 222 (टाइगरशार्क्स) देश की पहली स्क्वाड्रन है जिसे ब्रह्मोस मिसाइल से लैस किया गया है। यह दक्षिण भारत में देश की पहली Su-30 MKI स्क्वाड्रन है जिसका बेस तंजावुर एयरफोर्स स्टेशन है। थल सेना के पास सैकड़ों ब्रह्मोस मिसाइलें हैं। नौसेना ने भी कई जंगी जहाजों, विनाशकों और फ्रिजेट्स पर यह मिसाइल तैनात कर रखी है।

### **सीमा पर इनकी तैनाती से ही घबरा गया था पाकिस्तान**

पिछले साल अगस्त में भारत ने संविधान के अनुच्छेद 370 के तहत जम्मू और कश्मीर को मिले विशेष दर्जे को खत्म कर दिया था। पाकिस्तान ने इसका खुला विरोध किया। आशंका थी कि पाकिस्तान आतंक के सहारे पलटवार की कोशिश कर सकता है। पाकिस्तानी सेना की ओर से भी कुछ नापाक हरकत की आशंका को देखते हुए भारत ने ब्रह्मोस मिसाइलों को सीमा पर तैनात किया तो उसके होश उड़ गए। पाकिस्तान के विदेश मंत्री शाह महमूद कुरैशी ने तो संयुक्त राष्ट्र को चिट्ठी लिख डाली थी कि भारत एलओसी पर मिसाइलें तैनात कर रहा है और वह किसी 'हरकत' की ताक में है।

### **अभी और कई नए रूपों में आएगी ब्रह्मोस**

ज्यादा रेंज वाली ब्रह्मोस मिसाइल पर रूस और भारत काम कर रहे हैं। इस अपग्रेड को पहले से बनी मिसाइलों में भी लागू किया जाएगा। ब्रह्मोस-II के नाम से एक हाइपरसोनिक क्रूज मिसाइल भी बनाई जा रही है जिसकी रेंज करीब 290 किलोमीटर होगी। यह मिसाइल मैच 8 की रफ्तार से उड़ेगी यानी अभी के लगभग दोगुना। यानी यह दुनिया की सबसे तेज हाइपरसोनिक मिसाइल होगी।

इसके अलावा ब्रह्मोस-एनजी (नेक्स्ट जेनरेशन) जो कि वर्तमान मिसाइल का एक मिनी वर्जन है, डिवेलप की जा रही है। यह मिसाइल अभी की मिसाइल के मुकाबले आधी वनी होगी। इसमें रडार क्रॉस सेक्शन भी कम होंगे जिससे दुश्मन के एयर डिफेंस सिस्टम के लिए इसका पता लगा पाना और मुश्किल हो जाएगा। इस मिसाइल को सुखोई, मिग, तेजस के अलावा राफेल व अन्य लड़ाकू विमानों के साथ जोड़ा जाएगा।

<https://navbharattimes.indiatimes.com/india/indian-army-brahmos-supersonic-cruise-missile-details-in-hindi/articleshow/79382134.cms?story=6>

## अंडमान निकोबार से हुआ BrahMos सुपरसोनिक मिसाइल का एक और टेस्ट, 400 KM से ज्यादा हुई रेंज

**ऋचा बाजपेई**

नई दिल्ली: भारत ने मंगलवार को एक बार फिर ब्रह्मोस सुपरसोनिक क्रूज मिसाइल का परीक्षण किया है। रक्षा सूत्रों की तरफ से बताया गया है कि भारत ने अंडमान निकोबार द्वीप से ब्रह्मोस सुपरसोनिक क्रूज मिसाइल के लैंड वर्जन का सफल परीक्षण किया है। इस मिसाइल का टारगेट क्षेत्र में मौजूद दूसरा द्वीप था। ब्रह्मोस का टेस्ट सुबह 10 के करीब किया गया है।

बढ़ गई मिसाइल की रेंज 24 नवंबर को हुआ ब्रह्मोस के टेस्ट ने सफलतापूर्वक अपने लक्ष्य को भेदा। इस टेस्ट को भारतीय सेना की तरफ से अंजाम दिया गया है। ब्रह्मोस मिसाइल रक्षा अनुसंधान एवं विकास (डीआरडीओ) की तरफ से तैयार किया गया है। नए टेस्ट के बाद अब मिसाइल की रेंज 400 किलोमीटर से ज्यादा हो गई है। ब्रह्मोस समेत बाकी मिसाइल्स के सभी



टेस्ट्स ऐसे समय में हो रहे हैं जब पूर्वी लद्दाख में लाइन ऑफ एक्चुअल कंट्रोल (एलएसी) पर चीन के साथ पांच माह से टकराव जारी है। विशेषज्ञों की मानें तो भारत ने स्पष्ट कर दिया है कि वह चीन की आक्रामकता के आगे नहीं झुकेगा। पिछले माह इंडियन एयरफोर्स (आईएएफ) ने भी ब्रह्मोस का परीक्षण किया था। उस समय मिसाइल ने 300 किलोमीटर तक के अपने लक्ष्य को भेदा था। पिछले दिनों डीआरडीओ की तरफ से बताया गया था कि नवंबर माह के अंतिम हफ्ते में ब्रह्मोस मिसाइलों के कई अहम टेस्ट्स किए जाने हैं। डीआरडीओ की तरफ से बताया गया था कि ये सभी टेस्ट्स हिंद महासागर क्षेत्र में होंगे।

### क्या हैं ब्रह्मोस की खूबियां

- ब्रह्मोस को डीआरडीओ और रूस की एनपीओ माशीनोस्ट्रोनिया मिलकर डेवलप कर रहे हैं।
- मिसाइल पनडुब्बी, जहाज, एयरक्राफ्ट या जमीन से भी लांच की जा सकती है।
- 2.8 मैक या 3,400 प्रति घंटे की रफ्तार और 3,700 किमी प्रतिघंटे की रफ्तार से हमला कर सकती है।
- ब्रह्मोस स्पीड में अमेरिकी सेना की मिसाइल टॉमहॉक से चार गुनी तेज है।
- इसकी रेंज 290 किमी से लेकर 300 किमी तक है।
- ब्रह्मोस का नाम दो नदियों भारत की ब्रह्मपुत्र और रूस को मोस्क्वा से मिलकर बना है।
- जहाज और जमीन से लांच होने पर यह मिसाइल 200 किलो वॉरहेड्स ले जा सकती है।
- वहीं एयरक्राफ्ट से लांच होने पर 300 किलो के वॉरहेड्स ले जाने में सक्षम।
- विशेषज्ञों की मानें तो 2.8 और 3.0 मैक की स्पीड इसे इंटरसेप्ट नहीं किया सकता है।

- अगर ऐसा करना है तो दुश्मनों को अपने सिस्टम को अपग्रेड करना होगा या फिर नया सिस्टम बनाना होगा।
- ब्रह्मोस को पहली बार 12 जून 2001 में इंटीग्रेटेड टेस्ट रेंज से लांच किया गया।
- 12 जून 2004 को इस मिसाइल को एक मोबाइल लांचर के जरिए लांच किया गया।
- भारत दुनिया का अकेला ऐसा देश है जिसके पास मैन्यूवरबल सुपरसोनिक क्रूज मिसाइल है।

<https://www.google.com/search?q=drdo+news&ie=utf-8&oe=utf-8&client=firefox-b-ab>



Wed, 25 Nov 2020

## चीन से तनाव के बीच भारत ने किया ब्रह्मोस सुपरसोनिक क्रूज मिसाइल का परीक्षण, जल-जमीन और हवा से भी दुश्मन को तबाह करने में सक्षम

नई दिल्ली: भारत ने आज सुबह 10 बजे अंडमान और निकोबार द्वीप समूह से जमीन में वार करने वाली ब्रह्मोस सुपरसोनिक क्रूज मिसाइल का सफलतापूर्वक परीक्षण किया है। परीक्षण के दौरान मिसाइल ने सीधे अपने टारगेट को मार गिराया। इसका टारगेट दूसरे द्वीप पर था। इसी महीने भारत ने बालासोर में किया क्विक रिएक्शन मिसाइल का सफल परीक्षण मिसाइल परीक्षण किया था।

ये परीक्षण ऐसे समय में किया गया है जब भारत और चीन के एलएसी पर विवाद चल रहे हैं। इस ट्रायल के बाद अब मिसाइल भारतीय सेना में शामिल होने के लिए तैयार है। आज सुबह 10 बजे इसका परीक्षण किया गया। इस टेस्ट को भारतीय सेना द्वारा किया गया जिसमें डीआरडीओ द्वारा बनाए गए मिसाइल सिस्टम के बनाए गए बहुत से रेजिमेंट हैं। इस मिसाइल की मार करने की क्षमता अब 400 किलोमीटर हो गई है।



ब्रह्मोस मिसाइल एक यूनीवर्सल लंबी रेंज सुपरसोनिक क्रूज मिसाइल सिस्टम है जिसे जमान, समुद्र और हवा से लांच किया जा सकता है। इस मिसाइल को भारतीय सेना, डीआरडीओ और रशिया ने बनाया है। इसके सिस्टम को दो वेरिएंट्स के हिसाब से बनाया गया है। एसे एंटी-शिप और लैंड-अटैक रोल के हिसाब से बनाया गया है। ब्रह्मोस मिलाइल भारतीय सेना और जलसेना में कमीशन की गई हैं। ब्रह्मोस सुपरसोनिक क्रूज मिसाइल सिस्टम अपना श्रेणी में पूरी दुनिया का सबसे तेज ऑपरेशनल सिस्टम है। हाल ही में डीआरडीओ ने मिसाइल की रेंज को 298 किलोमीटर से 450 किलोमाटर तक बढ़ाया है।

पिछले दो महीनों में डीआरडीओ ने पहले की और नई मिसाइलों का सफल परीक्षण किया है। इसमें शौर्य मिसाइल सिस्टम भी शामिल है जो 800 किलोमीटर कर मार कर सकता है। इसमें हाइपरसोनिक मिसाइल टेक्नोलॉजी भी शामिल है। पिछले महीने इंडियन नेवी ने अपने युद्धपोत आईएनएस चेन्नई से ब्रह्मोस मिसाइल का सफल परीक्षण किया था। यह 400 किलोमीटर तक हमला करने में सक्षम है।

भारत अब सुपरसोनिक क्रूज मिसाइल का निर्यात करने के लिए बाजारों की तलाश कर रहा है। इन मिसाइलों को डीआरडीओ के प्रोजेक्ट पीजे10 के तहत बनाया गया है। इन मिसाइलों को 90 के दशक के बाद भारत और रूस के साझा प्रयास के बाद तीनों सेनाओं में शामिल किया था।

<https://www.livehindustan.com/national/story-india-successfully-tests-brahmos-supersonic-cruise-missile-can-attack-upto-400-kms-3645361.html>

**FINANCIAL EXPRESS**  
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Wed, 25 Nov 2020

## भारत ने ब्रह्मोस सुपरसोनिक क्रूज मिसाइल के लैंड अटैक वर्जन का किया सफल परीक्षण, 400 किलोमीटर से ज्यादा दूर तक कर सकेगी वार

**भारत ने मंगलवार को ब्रह्मोस सुपरसोनिक क्रूज मिसाइल  
के लैंड अटैक वर्जन का सफलतापूर्वक परीक्षण किया है**

भारत ने मंगलवार को ब्रह्मोस सुपरसोनिक क्रूज मिसाइल के लैंड अटैक वर्जन का सफलतापूर्वक परीक्षण किया है। ANI के मुताबिक, इसे अंडमान और निकोबार द्वीप समूह के क्षेत्र से किया गया। रिपोर्ट के मुताबिक, सुपरसोनिक क्रूज मिसाइल को आज सुबह 10 बजे टेस्ट फायर किया गया और इसने दूसरे द्वीप पर मौजूद अपने टारगेट को सफलतापूर्वक हिट किया।

ANI के मुताबिक, भारतीय सेना ने यह टेस्ट किया है, जिसमें DRDO द्वारा विकसित मिसाइल सिस्टम के बहुत से रेजिमेंट शामिल हैं। ब्रह्मोस मिसाइल की स्ट्राइक रेंज बढ़ाकर अब 400 किलोमीटर से ज्यादा कर दी गई है। ब्रह्मोस सुपरसोनिक क्रूज मिसाइल अपनी श्रेणी में दुनिया की सबसे तेज ऑपरेशनल सिस्टम है। और हाल ही में, DRDO ने मिसाइल सिस्टम के न को मौजूदा 298 किलोमीटर से बढ़ाकर करीब 450 किलोमीटर कर दिया है।



भारत ने मंगलवार को ब्रह्मोस सुपरसोनिक क्रूज मिसाइल के लैंड अटैक वर्जन का सफलतापूर्वक परीक्षण किया है। (File Pic)

### शौर्या मिसाइल का भी किया गया था सफल परीक्षण

पिछले दो महीनों में DRDO दोनों नई और मौजूदा मिसाइल सिस्टम के परीक्षण में सफल रहा है। इनमें शौर्या मिसाइल सिस्टम शामिल है, जो 800 किलोमीटर से ज्यादा दूरी पर मौजूद लक्ष्य को हिट कर सकता है। रिपोर्ट में कहा गया है कि भारतीय नेवी ने ब्रह्मोस मिसाइल की टेस्ट फायरिंग आईएनएस चैन्नई से भी की थी, जिससे इसकी गहरे समंदरों में 400 किलोमीटर से ज्यादा की रेंज में टारगेट को हिट करने की इसकी क्षमता दिखाई जा सके।

भारत सुपरसोनिक क्रूज मिसाइल के लिए निर्यात के बाजार भी खोजने पर काम कर रहा है, जिसे DRDO ने बड़े स्तर पर अपने प्रोजेक्ट PJ 10 के तहत देश में विकसित किया है। 90 के दशक के आखिरी में भारत और रूस के बीच ज्वाइंट वेंचर लॉन्च होने के बाद, ब्रह्मोस सुपरसोनिक क्रूज मिसाइल सभी तीनों सेनाओं की फोर्स के लिए महत्वपूर्ण हथियार बन गया।

इससे पहले सितंबर में DRDO ने स्वदेशी बूस्टर और एयरफ्रेम सेक्शन के साथ ही कई अन्य 'मेड इन इंडिया' उप प्रणालियों से लैस सतह से सतह तक मार करने वाली सुपरसोनिक क्रूज मिसाइल ब्रह्मोस का ओडिशा में आईटीआर, बालासोर से सफलतापूर्वक परीक्षण किया था।

<https://www.financialexpress.com/hindi/india-news/india-successfully-test-land-attack-version-of-brahmos-supersonic-cruise-missile-can-target-over-400-kilometer-range/2135444/>



Wed, 25 Nov 2020

## Game-changer for Indian Army – Why ‘Made in India’ ATAGS give powerful artillery edge to defense forces?

*By Rajesh Sinha*

One of the real successes of the ‘Made in India’ story in defense manufacturing has been the Advanced Towed Artillery Gun System (ATAGS). This 155-mm, 52-caliber artillery gun reportedly is undergoing the last stages of the trial, and could soon be inducted into the Indian Army.

In September 2012, the Ministry of Defence gave the green signal for this ambitious project. And by December 2016, ATAGS was made ready for trials.

Unlike most of the other indigenous defense ventures, be it the LCA Tejas, ALH Dhruva, MBT Arjuna, or nuclear submarine Arihant — all of which took many years or decades to become operational — the ATAGS could be regarded as unique because it is a world-class ‘Made in India’ product with more than 90 percent indigenous content that is certain to enhance the firepower of the army substantially.



It is not that the project did not have setbacks. Initially, the trials had to be delayed on account of the outbreak of the Covid-19 pandemic. After the development process was completed, trials in different weather conditions had to be undertaken.

However, during summer trials in Rajasthan, the bursting of a gun barrel raised questions about the efficacy of the weapon. Consequently, its induction into the army too, got slightly delayed.

This was not an isolated incident of an artillery gun facing trouble during trials. In fact, such incidents have been reported from all major countries, including the US, France, Germany, Israel during the development process of their artillery guns.

Even in India, the upgraded version of Dhanush and the US-made imported M777 ultra-light Howitzer had to endure such cases of barrel burst in the trial stages. In most cases, faulty ammunition was reported to be the reason behind the problem.

Subsequent technical investigations and rectifications led to relevant changes, and the ATAGS seems now ready to be part of the army’s big offensive weaponry. In fact, media reports suggest that the government has already given in-principle approval for the acquisition of 150 ATAGS for the Indian Army at an early date.

Some of the important developments associated with its progress are that it is an indigenous weapon system that is vital in the context of the army’s self-reliant rationalization plan in the contemporary cost-cutting scenario. ATAGS is also unique since it has turned out to be a great example of a successful public-private partnership.

The major defense laboratories involved in ATAGS development are the Defence Research Development Organisation's (DRDO) Armament Research Development Establishment (ARDE) Pune, Defence Electronics Application Laboratory, Dehradun, and Centre for Artificial Intelligence and Robotics, Bengaluru along with major corporates like Bharat Forge, TATA Power SED, Ashok Leyland, and Cummins.

This success will spur more such ventures where defense PSUs and top corporate companies will together develop ambitious indigenous weaponry, saving the scarce forex for India and paving the way for their exports to other countries.

Other unique features of ATAGS include its ability to fire five-six rounds. All contemporary guns with other major militaries around the world can fire only three rounds. Also, its ability to allow loading of greater ammunition onto the target will make it difficult for enemy soldiers to take cover in the event of a real-time conflict.

Another best for ATAGS is its ability to fire the maximum range of 48 kilometers that no artillery gun in the world currently possesses. Experts have attributed this exceptional ability of ATAGS to its 25-liter chamber capacity whereas any comparable artillery gun only has a 23-liter chamber. Its magazine capacity for five-six rounds against the usual three-rounds has pushed its weight and thus requires a larger chamber.

The addition of battery engines has made the gun heavier; its mobility is one factor that initially raised some concerns. Yet the army has gladly accepted it on account of the strategic electrical system this gun is equipped with. The ATAGS has a world-class, digitally controlled communication system too.

In addition, from the deserts of Rajasthan to the high altitudes of Sikkim at -16 degrees Celsius, its trials have been proved very successful.

Since the entry of controversy-ridden Bofors into the Indian Army way back in the 1990s and subsequent blacklisting of the company, the army has been on the continuous lookout for a state-of-the-art 155-mm gun. It could prove to be critical and war-winner, especially in places like Line of Control (LoC), on the Pakistan border where the terrorists are ever ready to infiltrate into India. Targeting them with ATAGS could make life miserable for the enemy.

The importance of ATAGS is both strategic and financial. Strategically, this gun has a greater range, firepower, sophisticated control, and communication system, and advanced batteries. Its technical and operational superiority as compared to other contemporary artilleries around the world will provide the army with a huge operational advantage.

For quite some time, the army has had its eyes on acquiring such guns so that its firing capability gets enhanced, especially along the borders against both Pakistan and China.

When the ATAGS development was going full steam, the army even had dropped its plan to move ahead with a proposed order to Elbit Systems of Israel for importing 400 artillery guns. Hence, a lot depended upon the success of ATAGS, and the DRDO along with Indian corporates did not let the army down.

In the next decade, the army has plans to acquire almost 3,000 artillery guns of 155mm range to further enhance and consolidate its firepower. Even ATAGS does well, India would be able to save a huge amount of foreign exchange. Further, it could also form a significant part of the ambitious export plans of Indian weaponry around the world in due course.

<https://eurasianimes.com/game-changer-for-indian-army-why-made-in-india-atags-give-powerful-artillery-edge-to-defense-forces/>



## What is Varunastra?

*Varunastra is a ship-launched, heavyweight, electrically-propelled anti-submarine torpedo capable of targeting quiet submarines, both in deep and shallow waters in an intense countermeasures environment*

*By Arfa Javaid*

In a major boost to Atma Nirbhar Bharat, the first Production unit of Heavy Weight Torpedo (HWT), Varunastra, developed by BDL Vishakhapatnam for Indian Navy is flagged off on 21 November 2020. The HWT is designed by the Naval Science and Technological Laboratory (NTSL), DRDO.

The delivery of the unit was flagged off by Secretary Department of Defence R&D and Chairman, DRDO, Dr. G. Satheesh Reddy in the presence of other senior officials of DRDO, Indian Navy and BDL.

### Varunastra

1. As per DRDO, Varunastra is a ship-launched, heavyweight, electrically-propelled anti-submarine torpedo capable of targeting quiet submarines, both in deep and shallow waters in an intense countermeasures environment.
2. Varunastra can be fired from all ASW ships capable of firing heavyweight torpedoes.
3. It was inducted by Indian Navy in 2016 and is named after a legendary weapon created by the Hindu God of the Oceans-- Varunastra.

### Specifications:

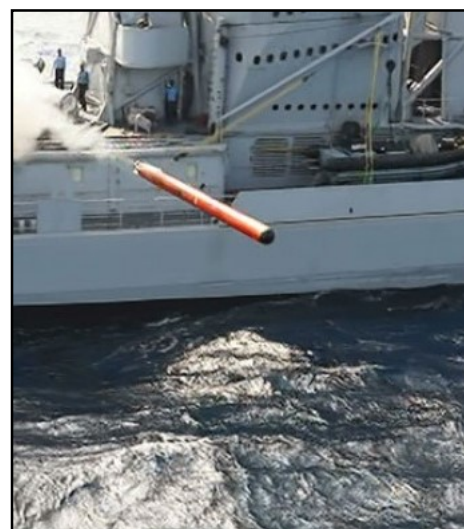
1. It weighs 1500 kg and is 7-8 metres long.
2. The operational range of Varunastra is 40 km.
3. The maximum depth is 400 metres.
4. The maximum speed it can attain is 74km per hour.
5. It is the only torpedo in the world to have a GPS-based locating aid.
6. It can carry a warhead weighing 250 kg.
7. It has been jointly developed by the Naval Science and Technology Laboratory (NTSL), Visakhapatnam and the Bharat Dynamics Limited -BDL (Hyderabad).
8. Varunastra is powered by Silver Oxide Zinc (AgOZn) batteries.
9. The torpedo can be launched both from Ship and Submarine.

### About BDL

1. Bharat Dynamics Limited (BDL) is an enterprise of Government of India under the Ministry of Defence.
2. It was established in Hyderabad in the year 1970 as a manufacturing base for guided missiles and allied defence equipment.
3. It is headquartered in Hyderabad, Telangana and has three manufacturing units located at Kanchanbagh, Hyderabad, Telangana; Bhanur, Medak district, Telangana and Visakhapatnam, Andhra Pradesh. Two New Units are planned at Ibrahimpatnam, Ranga Reddy district, Telangana and Amravati, Maharashtra.



Varunastra



4. It is associated with DRDO for various missile programmes and is the production agency for Quick Reaction Surface to Air Missile (QRSAM), for which, trials were conducted successfully.
5. It is also the production agency for Astra Air- to- Air Missile System which is indigenously developed by the DRDO for the Indian Air Force (IAF).

Image Credits: DRDO

<https://www.jagranjosh.com/general-knowledge/varunastra-heavy-weight-torpedo-1606128587-1>

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Mon, 23 Nov 2020

## Philippines close to Indo-Russian cruise missile purchase: Reports

*The BrahMos supersonic cruise missile would give Manila a potent deterrent to Chinese assertiveness in the South China Sea*

*By Sebastian Strangio*

The Philippines government could sign an agreement for the purchase of the Indo-Russian BrahMos cruise missile early next year, after a COVID-19-induced delay, according to media reports.

The Philippines has long expressed interest in purchasing the advanced weapons system, which has been jointly developed by the Russian and Indian governments. In December 2019, Philippine Defense Secretary Delfin Lorenzana announced that that Philippines was preparing to purchase two batteries of BrahMos missiles, as part of the Armed Forces of the Philippines' 2018-22 modernization program. (Each battery includes three mobile autonomous launchers with two or three missile tubes each.) "Signing of the contract will be in 2020. Possibly on the first or second quarter," he said, according to the state-run Philippine New Agency.



Credit: Flickr/Vasilyev Serge

The COVID-19 pandemic appears to have delayed the purchase, but it seems likely to go ahead as soon as early 2021.

The reports came after Roman Babushkin, Russia's deputy chief of mission in New Delhi, told an online media briefing in mid-November that recent tests of the missile system had been successful, and that BrahMos was planning to begin "exporting it to third countries beginning with the Philippines."

While Arsenio Andolong, a spokesman at the Philippine Department of National Defense, told Nikkei Asia that the purchase of the BrahMos missile system "is still under evaluation," a recent report in the Hindustan Times suggests that the deal will be signed during a potential summit between Indian Prime Minister Narendra Modi and Philippine President Rodrigo Duterte. The meeting has not been confirmed, but is expected to take place in February.

The world's fastest supersonic cruise missile, the BrahMos is the brainchild of BrahMos Aerospace, a joint venture between India and Russia which was set up in India in 1998. BrahMos is a portmanteau of the names of two rivers: India's Brahmaputra and Russia's Moskva.

The missile can be launched from submarines, ships, aircraft or from land platforms, and can carry conventional warheads weighing up to 300 kilograms. Equipped with stealth technology

and an advanced guidance system, the BrahMos flies at nearly three times the speed of sound, making it nearly impossible for targets to evade or intercept.

Last month, a naval version of the BrahMos missile was successfully test fired from an indigenously-built stealth destroyer of the Indian Navy in the Arabian sea. Days later, the Indian Air Force test-fired an air-launched version of the missile from a Sukhoi fighter aircraft in the Bay of Bengal.

Apart from the Philippines, countries like Thailand, Vietnam, and Indonesia have reportedly shown interest to purchase the BrahMos cruise missile. The Philippines is reportedly interested in purchasing the land-based variant.

If it eventuates, the missile, known in defense circles as a “carrier killer,” would be a significant acquisition for the AFP, which has struggled to defend sovereign claims from maritime incursions by China. As Prashanth Parameswaran wrote in these pages when the first reports of a potential Philippine purchase began to emerge, the missiles would be “ideal for the service’s land-based territorial defense operations.” By bringing Chinese assets in the South China Sea within the 400-kilometer range of the BrahMos missile, the acquisition would provide a stiff deterrent to further Chinese assertiveness in the disputed region.

It would also mark a great leap forward for the incipient security ties between New Delhi and Manila. Earlier this month, the two nations held an online meeting of their commission on bilateral cooperation. The meeting was co-chaired by India’s External Affairs Minister S. Jaishankar and the Philippines’ Foreign Secretary Teodoro Locsin Jr., who agreed to push forward the two countries’ defense engagement and maritime cooperation, beginning with military training exercises, capacity-building, goodwill visits and procurement.

Viewed in wider context, the Philippines purchase of the Indo-Russian weapons system would mark the latest step in an incremental regional arms race that has taken place due to China’s growing power and military might. With all nations armed with increasingly deadly and sophisticated weapons systems, there is a higher chance than ever of a small incident or miscommunication spiraling into a larger conflict. In that sense, it is indicative of a worrying trend. *(Sebastian Strangio is Southeast Asia Editor at The Diplomat.)*

<https://thediplomat.com/2020/11/philippines-close-to-indo-russian-cruise-missile-purchase-reports/>



Wed, 25 Nov 2020

## BrahMos program in progress, funds yet to be available: DND

*By Priam Nepomuceno*

Manila: Department of National Defense (DND) Secretary Delfin Lorenzana said the program to acquire medium-range ramjet supersonic BrahMos cruise missiles is moving forward but getting enough funds for this remains a challenge.

He made this comment when asked by the Philippine News Agency (PNA) on updates regarding the plans to acquire the cruise missile which was jointly developed by Russia and India.

"The Brahmos (program) is moving forward but the challenge now is (the) funding," Lorenzana said in a message to PNA late Monday.

When asked for an estimate on how fast the Philippines can get the missile into service, the DND chief said this is dependent on how fast the funds would be made available.



Defense Secretary Delfin Lorenzana. *(File photo)*

Earlier, Lorenzana said they are planning to acquire at least "two batteries" of the BrahMos cruise missiles with each battery having three mobile autonomous launchers with two or three missile tubes each.

The procurement would be via "government-to-government mode".

If acquired, the missiles will be utilized to fulfill the Philippine Army's (PA) coastal defense missions. Aside from the PA, the DND chief said the weapons can also be used by the Philippine Air Force.

Once the missiles are delivered, Lorenzana said the BrahMos will be the first Philippine weaponry with deterrent capability.

Acquisition of a land-based missile system is under Horizon Two of the Revised Armed Forces of the Philippines Modernization Program which is slated for 2018 to 2022 and geared for the acquisition of equipment geared for external defense and has a budget of PHP300 billion. (PNA)

<https://www.pna.gov.ph/articles/1122736>

## Defence News

### Defence Strategic: National/International

THE TIMES OF INDIA

Wed, 25 Nov 2020

## Govt approves joint military logistics nodes in run-up to theatre commands

By Rajat Pandit

New Delhi: The government has now formally approved the first set of joint structures to handle logistics in the 15-lakh strong armed forces, in a step towards injecting some desperately-required integration among the three Services and the eventual creation of unified theatre commands.

The first three joint logistics nodes (JLNs) at Mumbai, Guwahati and Port Blair will handle small arms ammunition, rations, FOL (fuels, oils and lubricants), general stores, civil-hired transport, aviation clothing, spares and engineering support for the Army, Navy and IAF to ensure cost-effectiveness in operations.

"These three experimental JLNs were functioning in an ad hoc manner till now. Now, the entire arrangement, structure and mandate has been formalized through the recent government sanction letter (GSL) approved by the President," said a senior officer on Tuesday.

Similar nodes will come up in other parts of the country as the integrated "functional" and "geographical or theatre" commands begin to take shape over the next two to three years.

"The JLNs will integrate the common logistics functioning of the three Services as a prelude towards complete jointness in the future," says the GSL. With each node to have a "lead Service" to handle all provisioning and procurements, it will be Navy in Mumbai, Army in Guwahati and the Andaman and Nicobar Command (ANC) in Port Blair.



Chief of defence staff General Bipin Rawat has been tasked with ushering in genuine synergy in planning, doctrines, acquisitions and operations among the Army, Navy and IAF, which often pull in different directions.

Towards this end, the tri-Service “functional” Air Defence Command (ADC), which will eventually be responsible for guarding the country’s airspace against hostile aircraft, missiles, helicopters and drones in an integrated manner, will be the first to be created.

The next will be the geographical theatre commands, with all assets and manpower of the three Services under a single operational commander. These will include a maritime command in peninsular India, one or two commands (a northern one west of Nepal and an eastern one east of Nepal) to handle China, one or two commands on the western front with Pakistan (one in J&K and the other to include Punjab, Gujarat and Rajasthan), as was earlier reported by TOI.

Gen Rawat, at a seminar last week, said these integrated commands will become “operational in the next two to three years”. India till now has only two unified commands, while there are as many as 17 single-service commands (Army 7, IAF 7 and Navy 3). The ANC, the only theatre command till now, was set up in October 2001. The “functional” Strategic Forces Command to handle the country’s nuclear arsenal, in turn, came up in January 2003.

<https://timesofindia.indiatimes.com/india/govt-approves-joint-military-logistics-nodes-in-run-up-to-theatre-commands/articleshow/79400139.cms>

## Telangana Today

Wed, 25 Nov 2020

### Air Marshal RD Mathur visits Hakimpet Air Force Station

*On arrival, he was received by AS Minhas, Air Officer Commanding, Air Commodore who briefed him on diverse flying training activities being undertaken at the station*

Hyderabad: Air Marshal RD Mathur, Air Officer Commanding-in-Chief (AOC-in-C), Training Command, Indian Air Force, visited the Air Force Station Hakimpet on Tuesday.

On arrival, he was received by AS Minhas, Air Officer Commanding, Air Commodore who briefed him on diverse flying training activities being undertaken at the station.

During the visit, he interacted with the Flying Instructors of the Fighter Training Wing and Helicopter Training School, and appreciated the sustained efforts put in by them in maintaining a healthy flying environment.

The Air Marshal also inspected and inaugurated the newly constructed communication and cyber building which would further enhance the overall operational capabilities of the base, a press release said.

<https://telanganatoday.com/air-marshal-rd-mathur-visits-hakimpet-air-force-station>



Air Marshal RD Mathur, AOC-in-C, Training Command inspecting the guard of honour at Air Force Station Hakimpet on Tuesday

Wed, 25 Nov 2020

## Indian Army Chief reviews security situation in Northeast region

*On arrival at Dimapur, the Army Chief was briefed by top army personnel on operational preparedness along the northern borders as well as operations in the hinterland of Assam, Nagaland, Manipur and Arunachal Pradesh. The COAS was also briefed on the progress of the ongoing Naga Peace talks*

*By Manjeet Singh Negi*

New Delhi: The Chief of Army Staff, General Manoj Mukund Naravane, arrived at Dimapur in Nagaland on Monday on a three-day visit to review the security situation in the Northeast Region.

On arrival at Dimapur, the Army Chief was briefed by top army personnel on operational preparedness along the northern borders as well as operations in the hinterland of Assam, Nagaland, Manipur and Arunachal Pradesh. The COAS was also briefed on the progress of the ongoing Naga Peace talks.

On 24 November, the COAS visited various Army and Assam Rifles Headquarters in Nagaland and Manipur to make a firsthand assessment of the ground situation. The COAS interacted extensively with the troops deployed in the remote areas and appreciated their state of operational preparedness, morale and conduct of people-friendly operations.

Later in the evening, General Naravane called on the Nagaland Governor RN Ravi and Chief Minister Neiphiu Rio to discuss the prevailing security situation in the state and assured the support of the army and Assam Rifles in maintaining peace in the state and ensuring security along the Indo-Myanmar border.

As part of Indian Army's efforts in contributing towards the development and equitable opportunities to all sections of the society, a new residential facility at Kohima Orphanage, to be run by Assam Rifles, will be inaugurated by the COAS on November 25, 2020 prior to his return to New Delhi.



Indian Army Chief General MM Naravane. (Photo: PTI)

<https://www.indiatoday.in/india/story/indian-army-chief-reviews-security-situation-in-northeast-region-1743750-2020-11-24>

## Veterans advise caution on China's terms

*Chinese army had laid down the condition that the Indian Army vacate the Chushul heights on Kailash range first as part of the disengagement process*

*By Imran Ahmad Siddiqui*

New Delhi: Military veterans have cautioned the Indian Army against the Chinese People's Liberation Army's "ulterior" motive behind setting conditions for the proposed disengagement process at the Pangong Lake where troops from the neighbouring country have reportedly occupied 8km within India-claimed lines.

The PLA is said to have asked the Indian side to vacate the dominating Chushul heights on the Kailash range first as part of the disengagement process on the northern flank of the Pangong Lake.

Although there is no official word from either the government or the Indian Army on the specifics of the disengagement plan being discussed, sources in the ministry had said last week that the Chinese army had laid down the condition that the Indian Army vacate the Chushul heights.

"It will be a big blunder if the Indian side considers this proposal as it will be like walking into a trap. The Indian Army should remain extra cautious as we have already witnessed how the PLA had used deception to launch an attack on our soldiers at the Galwan Valley on June 15 even though both sides had agreed in principle to disengage," a retired army general said.

Twenty Indian soldiers and an unspecified number of Chinese troops were killed in the violence.

A former lieutenant general said the Chinese had been intentionally dragging the disengagement dialogue and were now setting conditions after eight rounds of military talks.

"Nothing stops the PLA from coming back to the Pangong Lake, even if they move back as part of the proposed disengagement plan," he said.

As per the latest ground assessment, he said, the Chinese troops continue to strengthen their positions by undertaking massive construction activities at multiple friction points in eastern Ladakh and are setting up additional winter camps and other facilities for soldiers.

"Why should the Indian Army vacate the strategic heights that are under their control? China has been the aggressor and they should pull back... and return to their side of the LAC first. India should reject outright proposals of any such conditions for disengagement," the former lieutenant general said.

Indian and Chinese troops have been locked in a face-off at multiple points — the Pangong Lake, Hot Springs, and the Depsang Plains — since May.

In September the Indian Army had occupied multiple ridges above 14,000 feet in the Chushul region in no man's land near the southern bank of the Pangong Lake from where they have been keeping a close watch on the PLA's troop movements.

The former lieutenant general also questioned Indian military commanders' move to take up with the PLA disengagement from only the Pangong Lake while not talking about resolution of the other friction points, especially the Depsang Plains.

At the Depsang Plains the PLA is said to have transgressed 18km inside India-claimed lines.

"Chinese domination and encroachment at Depsang is 18km deep but it is shocking that it is not even discussed. India should take up all friction points forcefully," the former lieutenant general said.



General V.P. Malik, who was the army chief during the 1999 Kargil War, said in a tweet: “My opinion on India China LAC face-off.... For lasting peace on LAC, military-diplomatic negotiations should first involve the whole of Ladakh-Tibet border — from Depsang to Chumar — and not in small segments. Implementation of the settlement thereafter should be worked segment-wise.”

A retired Intelligence Bureau director said there was a complete breakdown of trust after the Galwan Valley incident.

The Indian Army last week had completed establishment of habitat facilities for its nearly 50,000 additional troops deployed along the LAC where temperatures have already reached minus 15-20 degrees Celsius.

This is the first time such a huge number of additional soldiers are being deployed in the forward areas of the LAC in the harsh terrain 12,000-14,000ft above sea level where temperatures are expected to dip to minus 30-40 degrees Celsius by next month.

Indian Army sources said the top brass was still awaiting the PLA’s response on the ninth round of military talks. “The talks were supposed to take place last week. We are still awaiting their response,” said an army official.

<https://www.telegraphindia.com/india/indian-army-veterans-advise-caution-on-chinas-terms/cid/1798534>



Wed, 25 Nov 2020

## **U.S. Air Force F/A-18s and Indian MiG-29s are wargaming (China Is Why)**

*Both countries have been strengthening their partnership as they eye the rise of China*

*By Peter Suci*

Last week during the joint Malabar exercises in the Indian Ocean, MiG-29Ks of the Indian Navy and F-18s of the U.S. Navy carried out simulated attacks on a surface force during multilateral naval exercises. The MiG-29s operated from the Indian Navy’s INS *Vikramaditya* aircraft carrier and coordinated firing on surface targets during Phase-2 of the Malabar 2020 exercises.

“The exercises conducted during MALABAR provided opportunities to enhance our interoperability and strengthens our maritime partnerships with India, Australia, and Japan,” said Capt. Elaine Collins, commander, Destroyer Squadron 9. “Our ability to replenish ships at sea, conduct live firing exercises and communicate with one another, ship-to-ship, demonstrates our cooperation and shared goals of fostering security and stability in the Indo-Pacific region.”

The U.S. Navy’s *Nimitz* Carrier Strike Group (CSG-11) took part in the Phase-2 operations to further strengthen the integration of its naval air forces through air and air defense exercises. It allowed U.S. aviators to work alongside those of the Indian Navy.

“MiG 29K’s of the IN and the F-18 of the U.S. Navy flew along with the IN’s maritime patrol aircraft P-8I and the USN AEW aircraft E2C Hawkeye in seamless coordination,” said the Indian Navy in a statement, reported by the Economic Times of India.





The second phase of the Malabar exercises also included a photo exercise, night operations, air defense exercises, helicopter cross-deck evolutions, carrier landing approaches, underway replenishment approaches, gunnery exercises, and antisubmarine warfare exercises.

“Operating with Australia, India, and Japan via cross-deck landings, carrier landing approaches and aerial refueling during Malabar has been instrumental in enhancing the compatibility of our naval air forces,” said Capt. Todd Cimicata, commander, Carrier Air Wing 17. “We are honored by the professionalism of our partners, and look forward to flying together again as we reinforce our mutual desire to improve maritime security in the global commons.”

This year marked the twenty-fourth iteration of annual exercise, which began in 1992. It started as a training exercise between the United States and India and over the years other nations have taken part. Japan joined the annual event in 2015 and Australia, which had last participated in 2007, rejoined this year. It was the latest in a series of exercises that have grown in scope and complexity in recent years to address the variety of shared threats to maritime security in the Indo-Pacific, where the U.S. Navy has had a significant role for more than seventy years promoting regional peace and security.

“Malabar is an important opportunity to demonstrate the strength of our strategic partnerships in a high-end exercise,” said Rear Adm. Jim Kirk, commander of CSG-11. “The *Nimitz* Strike Group team is grateful to join our Australian, Indian and Japanese partners and increase our readiness and interoperability.”

CSG-11 is currently deployed to the 7th Fleet area of operations in support of a free and open Indo-Pacific. It had been operating in the waters of the north Arabian Sea for training, and recently rounded the Strait of Hormuz to join the exercises. As the U.S. Navy’s largest numbered fleet, the U.S. 7th Fleet interacts with thirty-five other maritime nations to build partnerships that foster maritime security, promote stability, and prevent conflict.

<https://nationalinterest.org/blog/buzz/us-air-force-fa-18s-and-indian-mig-29s-are-wargaming-china-why-173148>

## 3-D printed electrodes free the gas

By Anne M Stark

Alkaline water electrolysis has been touted as a path to establish a hydrogen economy by converting intermittent renewable energies into clean hydrogen-based chemical energy.

However, current technology has achieved only low current densities and voltage efficiencies.

To make electrolysis more resourceful, a Lawrence Livermore National Laboratory (LLNL) team partnered with the University of California, Santa Cruz and two other institutions to develop a 3-D-printed electrode that lessens the problems that occur with gas bubbles that are generated in the process.

One key to making electrolysis achieve higher current density comes down to the gas bubbles created in the process. The bubbles often mingle together, jam and get trapped, making it difficult for them to escape.

"This new electrode gets rid of the gas bubbles faster. You don't want the bubbles to be trapped in the material; you want to be able to pull them out as quickly as possible and use them as a fuel source," said LLNL materials scientist Cheng Zhu, the lead LLNL author of a paper appearing in *Advanced Energy Materials*.

The unique 3-D-printed architecture of the new electrode suppressed gas bubble coalescence, jamming and trapping, and resulted in rapid bubble release. The team found that the current density was 50 times better than the laboratory standard.

The team also used simulations to figure out how the gas forms, how it escapes and the rate at which it escapes. Because you can't see this process inside of an electrode, the simulations were critical in the design.

"The modeling helped us figure out the fundamental science of the phenomena we saw happening," said Rongpei Shi, the LLNL materials scientist who conducted the simulations. "The electrodes are not transparent so you can't look in there and see what's going on. The controlled platform and modeling are fairly unprecedented to find out about the physics going on inside the electrode."

The work demonstrates a new approach to the design of 3-D electrodes to enable rapid bubble transport and release to enhance the total electrode catalytic activity at commercially relevant current densities.

"There has been a lot of work done on the material end of electrolysis, looking for electrode catalyst materials. What this team showed is that the actual architecture of the components matter just as much, especially at high production rates," said Brandon Wood, LLNL's associate program leader for Hydrogen and Computational Energy Materials in the Materials Science Division and a co-author of the paper.

**More information:** Tianyi Kou et al. Periodic Porous 3D Electrodes Mitigate Gas Bubble Traffic during Alkaline Water Electrolysis at High Current Densities, *Advanced Energy Materials* (2020). [DOI: 10.1002/aenm.202002955](https://doi.org/10.1002/aenm.202002955)

**Journal information:** [Advanced Energy Materials](https://phys.org/news/2020-11-d-electrodes-free-gas.html)  
<https://phys.org/news/2020-11-d-electrodes-free-gas.html>

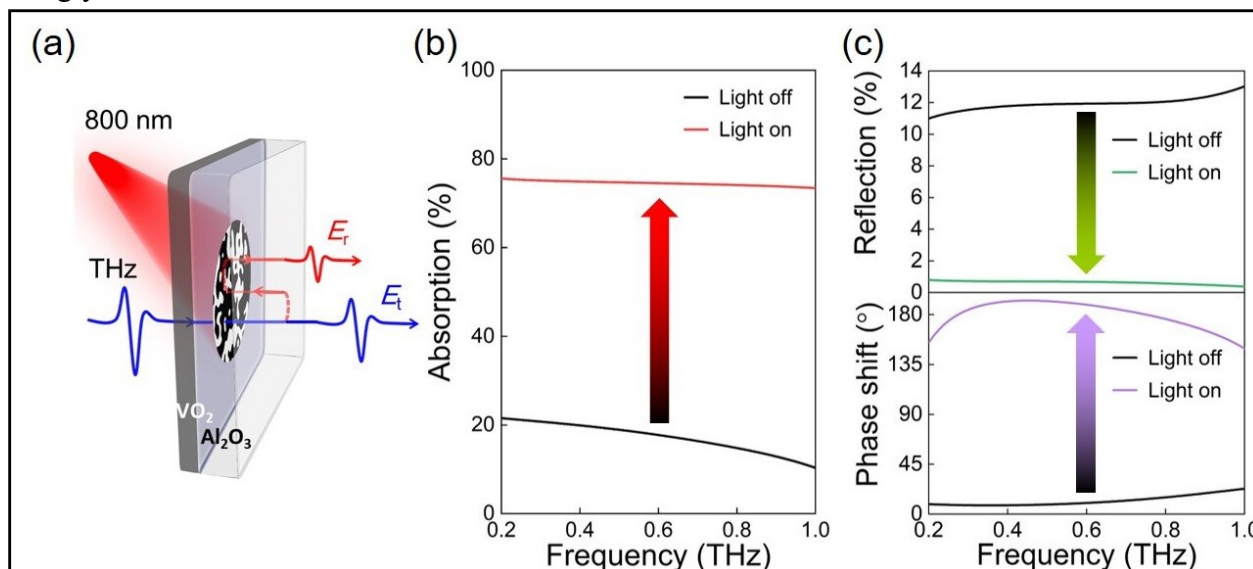


Architected 3-D electrodes: Managing bubble migration in gas evolution reactions at high current densities. Credit: Yat Li.

## Researchers invent broad-band tunable terahertz absorber

By Zhang Nannan

Recently, a research team led by Prof. SHENG Zhigao from the High Magnetic Field Laboratory of the Hefei Institutes of Physical Science (HFIPS), along with collaborators in HFIPS and ShanghaiTech University, invented a broad-band tunable terahertz (THz) absorber based on a strongly correlated electron oxide material.



(a) Schematic of THz pulse propagation through the VO<sub>2</sub> film on the Al<sub>2</sub>O<sub>3</sub> substrate. (b) Measured the change of THz absorption of VO<sub>2</sub> film with and without light. (c) Measured the change of THz reflection and reflection phase shift of VO<sub>2</sub> film with and without light. Credit: REN Zhuang

THz Absorbers have attracted the attention of many researchers with extensive application prospects in THz wave shielding, THz imaging, and THz sensitive thermal detecting. Therefore, the absorbers with not only strong absorption and broad-band absorption bandwidth, but also tunable characteristics are required.

By introducing a strongly correlated electron oxide material as a functional layer, the team realized the broad-band tunable THz spectrum properties in this strongly correlated electron device via multilayer dielectric structure design and light pump method.

The chosen strongly correlated electron material VO<sub>2</sub> was an excellent candidate for active THz modulation, as the conductivity, dielectric constant, as well as optical properties got a dramatic switching during the insulator-metal transition at TC = 340 K, and this transition could be tuned by temperature, electric field, and light.

By utilizing light pumping, more than 74% absorption modulation depth was achieved in this multilayer structure device. Furthermore, antireflection (the reflection is near zero) and broad-band  $\pi$ -phase shift of reflection THz waves were realized at a certain pump fluence.

This research, after a variety of tests and analyses, clarified the physical origin of these active THz multifunctional modulations.

**More information:** Zhuang Ren et al. Photoinduced Broad-band Tunable Terahertz Absorber Based on a VO<sub>2</sub> Thin Film, *ACS Applied Materials & Interfaces* (2020). DOI: [10.1021/acsami.0c15297](https://doi.org/10.1021/acsami.0c15297)

**Journal information:** *ACS Applied Materials and Interfaces*  
<https://phys.org/news/2020-11-broad-band-tunable-terahertz-absorber.html>

# Scientists find water microdroplets can transform into hydrogen peroxide when condensing on cold surfaces

By Adam Hadhazy

In its bulk liquid form, whether in a bathtub or an ocean, water is a relatively benign substance with little chemical activity. But down at the scale of tiny droplets, water can turn surprisingly reactive, Stanford researchers have discovered.

In microdroplets of water, just millionths of a meter wide, a portion of the  $\text{H}_2\text{O}$  molecules present can convert into a close chemical cousin, hydrogen peroxide,  $\text{H}_2\text{O}_2$ , a harsh chemical commonly used as a disinfectant and hair bleaching agent.

Stanford scientists first reported this unexpected behavior in forcibly sprayed microdroplets of water last year. Now in a new study, the research team has shown the same Jekyll-and-Hyde transformation happens when microdroplets simply condense from the air onto cold surfaces. The new results suggest that water's hydrogen peroxide transformation is a general phenomenon, occurring in fogs, mists, raindrops and wherever else microdroplets form naturally.

The surprising discovery could lead to greener methods for disinfecting surfaces or promoting chemical reactions. "We've shown that the process of forming hydrogen peroxide in water droplets is a widespread and surprising phenomenon that's been happening right under our noses," said study senior author Richard Zare, the Marguerite Blake Wilbur Professor in Natural Science and a professor of chemistry in the Stanford School of Humanities and Sciences.

The researchers also speculate that this newly recognized chemical ability of water could have played a key role in jumpstarting the chemistry for life on Earth billions of years ago, as well as produced our planet's first atmospheric oxygen before life emerged. "This spontaneous production of hydrogen peroxide may be a missing part of the story of how the building blocks of life were formed on early," Zare said.

The co-lead authors of the new study, published in *Proceedings of the National Academy of Sciences*, are Stanford staff scientists Jae Kyoo Lee and Hyun Soo Han.

Along with Zare and other Stanford colleagues, Lee and Han made the initial discovery of hydrogen peroxide production in water microdroplets last year. Some outside researchers who went over the study's results were skeptical, Zare said, that such a potentially common phenomenon could have gone undiscovered for so long. Debate also ensued over just how the hydrogen peroxide would ever actually form.

"The argument was that people have been studying water aerosols for years, and of course water is ubiquitous and has been intensively studied since the dawn of modern science, so if this hydrogen peroxide formation in microdroplets were real, surely someone would have seen it already," said Zare. "That led us to want to explore the phenomenon further, to see in what other circumstances it might occur, as well as learn more about the fundamental chemistry going on."



Photo shows water microdroplet condensate formed on the surface of a glass container containing cold water (left) and an image of water microdroplets formed on a polished silicon surface (right). Credit: Jae Kyoo Lee and Hyun Soo Han

## Microdroplets made another way

Zare and colleagues decided to investigate condensation, a scenario where microdroplets readily form naturally, without the aid of an external force such as a nebulizer instrument. Condensation occurs when water vapor (gas) in the air transitions into a liquid upon contacting a cooler surface; for instance, when the bathroom mirror fogs over after a shower.

The Stanford team condensed water into multiple chilled materials, including silicon, glass, plastic and metal. The researchers then wiped a test strip that changes color in the presence of hydrogen peroxide over the condensed water. Sure enough, the strip turned blue. The low, yet detectable amounts of hydrogen peroxide (on the order of parts per million) that formed varied based on factors such as the temperature of the surface and the relative humidity in the test chamber. The researchers also noted that the hydrogen peroxide formed in microdroplets became diluted as the size of the water droplets grew, which might explain why this chemical transformation had been overlooked for so long.

The new experiments also support the researchers' initial hypothesis about how the hydrogen peroxide was forming. They demonstrated that a strong electric field generated at the interface of water and air, right at the microdroplet's periphery, seems to activate water molecules, forming various so-called reactive oxygen species. These species are unstable molecular fragments that can quickly react with other molecules to yield hydrogen peroxide.

### A process always with us and well before us

Chemistry of this sort at the microdroplet level could have empowered the chemical transition from non-life to life on Earth over four eons ago, Zare said. The origin of life has a sort of chicken-or-egg dilemma, where catalyst molecules that speed up chemical reactions, and which appear necessary to jumpstart the chemistry of life, require life itself to make the catalyst molecules in the first place. But the natural creation of hydrogen peroxide could have instead promoted reactions leading to the molecular building blocks that ultimately assembled into complex, self-replicating entities.

Zare speculates that this ancient and widespread chemical reaction could have even provided a source of oxygen for early life (since hydrogen peroxide breaks down into water and oxygen molecules) before the appearance of organisms that could produce oxygen themselves through photosynthesis.

Zare's team is presently looking into how hydrogen peroxide production via microdroplets might be harnessed for cleaning and disinfecting purposes. One intriguing possibility, Zare suggests, is using microdroplets and their attendant H<sub>2</sub>O<sub>2</sub> to eliminate SARS-CoV-2 (the virus that causes COVID-19) from surfaces.

"With this new study and our continuing work, we're explaining how and why water droplets are so markedly different from bulk water in terms of chemical reactivity," said Zare. "It's amazing that chemistry-wise, water still has some tricks up its sleeve."

**More information:** Jae Kyoo Lee et al. Condensing water vapor to droplets generates hydrogen peroxide, *Proceedings of the National Academy of Sciences* (2020). DOI: [10.1073/pnas.2020158117](https://doi.org/10.1073/pnas.2020158117)

**Journal information:** *Proceedings of the National Academy of Sciences*  
<https://phys.org/news/2020-11-scientists-microdroplets-hydrogen-peroxide-condensing.html>

# Researchers decipher structure of promising metal organic frameworks

By David L. Chandler

A class of materials called metal organic frameworks, or MOFs, has attracted considerable interest over the last several years for a variety of potential energy-related applications—especially since researchers discovered that these typically insulating materials could also be made electrically conductive.

Thanks to MOFs' extraordinary combination of porosity and conductivity, this finding opened the possibility of new applications in batteries, fuel cells, supercapacitors, electrocatalysts, and specialized chemical sensors. But the process of developing specific MOF materials that possess the desired characteristics has been slow. That's largely because it's been hard to figure out their exact molecular structure and how it influences the material's properties.

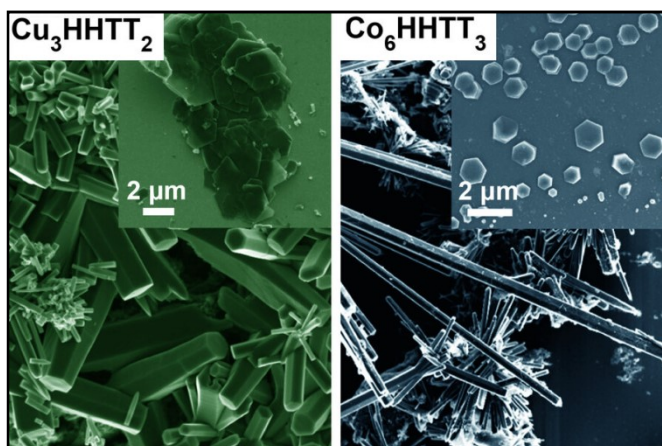
Now, researchers at MIT and other institutions have found a way to control the growth of crystals of several kinds of MOFs. This made it possible to produce crystals large enough to be probed by a battery of tests, enabling the team to finally decode the structure of these materials, which resemble the two-dimensional hexagonal lattices of materials like graphene.

The findings are described today in the journal *Nature Materials*, in a paper by a team of 20 at MIT and other universities in the U.S., China, and Sweden, led by W. M. Keck Professor of Energy Mircea Dincă from MIT's Department of Chemistry.

Since conductive MOFs were first discovered a few years ago, Dincă says, many teams have been working to develop versions for many different applications, "but nobody had been able to get a structure of the material with so much detail." The better the details of those structures are understood, he says, "it helps you design better materials, and much faster. And that's what we've done here: We provided the first detailed crystal structure at atomic resolution."

The difficulty in growing crystals that were large enough for such studies, he says, lies in the chemical bonds within the MOFs. These materials consist of a lattice of metal atoms and organic molecules that tend to form into crooked needle- or thread-like crystals, because the chemical bonds that connect the atoms in the plane of their hexagonal lattice are harder to form and harder to break. In contrast, the bonds in the vertical direction are much weaker and so keep breaking and reforming at a faster rate, causing the structures to rise faster than they can spread out. The resulting spindly crystals were far too small to be characterized by most available tools.

The team solved that problem by changing the molecular structure of one of the organic compounds in the MOF so that it changed the balance of electron density and the way it interacts with the metal. This reversed the imbalance in the bond strengths and growth rates, thus allowing much larger crystal sheets to form. These larger crystals were then analyzed using a battery of high-resolution diffraction-based imaging techniques.



Researchers at MIT and other institutions have found a way to stabilize the growth of crystals of several kinds of metal organic frameworks, or MOFs. This image shows two scanning electron microscopy (SEM) micrographs of  $\text{Cu}_3\text{HHTT}_2$  and  $\text{Co}_6\text{HHTT}_3$  that can be isolated on-demand with either rod- or plate-like (inset) morphology by varying the synthetic conditions. Credit: Massachusetts Institute of Technology

As was the case with graphene, finding ways to produce larger sheets of the material could be a key to unlocking the potential of this type of MOFs, Dincă says. Initially graphene could only be produced by using sticky tape to peel off single-atom-thick layers from a block of graphite, but over time methods have been developed to directly produce sheets large enough to be useful. The hope is that the techniques developed in this study could help pave the way to similar advances for MOFs, Dincă says.

"This is basically providing a basis and a blueprint for making large crystals of two-dimensional MOFs," he says.

As with graphene, but unlike most other conductive materials, the conductive MOFs have a strong directionality to their electrical conductivity: They conduct much more freely along the plane of the sheet of material than in the perpendicular direction.

This property, combined with the material's very high porosity, could make it a strong candidate to be used as an electrode material for batteries, fuel cells, or supercapacitors. And when its organic components have certain groups of atoms attached to them that bond to particular other compounds, they could be used as very sensitive chemical detectors.

Graphene and the handful of other 2-D materials known have opened up a wide swath of research in potential applications in electronics and other fields, but those materials have essentially fixed properties. Because MOFs share many of those materials' characteristics, but form a broad family of possible variations with varying properties, they should allow researchers to design the specific kinds of materials needed for a particular use, Dincă says.

For fuel cells, for example, "you want something that has a lot of active sites" for reactivity on the large surface area provided by the structure with its open latticework, he says. Or for a sensor to monitor levels of a particular gas such as carbon dioxide, "you want something that is specific and doesn't give false positives." These kinds of properties can be engineered in through the selection of the organic compounds used to make the MOFs, he says.

**More information:** Jin-Hu Dou et al. Atomically precise single-crystal structures of electrically conducting 2D metal–organic frameworks, *Nature Materials* (2020). DOI: [10.1038/s41563-020-00847-7](https://doi.org/10.1038/s41563-020-00847-7)

**Journal information:** [Nature Materials](https://phys.org/news/2020-11-decipher-metal-frameworks.html)  
<https://phys.org/news/2020-11-decipher-metal-frameworks.html>



Wed, 25 Nov 2020

## AI algorithm identifies new compound potentially useful for photonic devices, biologically inspired computers

When the words "artificial intelligence" (AI) come to mind, your first thoughts may be of super-smart computers, or robots that perform tasks without needing any help from humans. Now, a multi-institutional team including researchers from the National Institute of Standards and Technology (NIST) has accomplished something not too far off: They developed an AI algorithm called CAMEO that discovered a potentially useful new material without requiring additional training from scientists. The AI system could help reduce the amount of trial-and-error time scientists spend in the lab, while maximizing productivity and efficiency in their research.

The research team published their work on CAMEO in *Nature Communications*.

In the field of materials science, scientists seek to discover new materials that can be used in specific applications, such as a "metal that's light but also strong for building a car, or one that can withstand high stresses and temperatures for a jet engine," said NIST researcher Aaron Gilad Kusne.

But finding such new materials usually takes a large number of coordinated experiments and time-consuming theoretical searches. If a researcher is interested in how a material's properties vary with different temperatures, then the researcher may need to run 10 experiments at 10 different temperatures. But temperature is just one parameter. If there are five parameters, each with 10 values, then that researcher must run the experiment  $10 \times 10 \times 10 \times 10 \times 10$  times, a total of 100,000 experiments. It's nearly impossible for a researcher to run that many experiments due to the years or decades it may take, Kusne said.

That's where CAMEO comes in. Short for Closed-Loop Autonomous System for Materials Exploration and Optimization, CAMEO can ensure that each experiment maximizes the scientist's knowledge and understanding, skipping over experiments that would give redundant information. Helping scientists reach their goals faster with fewer experiments also enables labs to use their limited resources more efficiently. But how is CAMEO able to do this?

### The Method Behind the Machine

Machine learning is a process in which computer programs can access data and process it themselves, automatically improving on their own instead of relying on repeated training. This is the basis for CAMEO, a self-learning AI that uses prediction and uncertainty to determine which experiment to try next.

As implied by its name, CAMEO looks for a useful new material by operating in a closed loop: It determines which experiment to run on a material, does the experiment, and collects the data. It can also ask for more information, such as the crystal structure of the desired material, from the scientist before running the next experiment, which is informed by all past experiments performed in the loop.

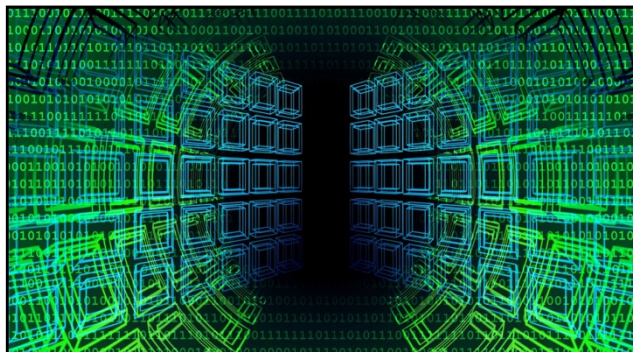
"The key to our experiment was that we were able to unleash CAMEO on a combinatorial library where we had made a large array of materials with all different compositions," said Ichiro Takeuchi, a materials science and engineering researcher and professor at the University of Maryland. In a usual combinatorial study, every material in the array would be measured sequentially to look for the compound with the best properties. Even with a fast measurement setup, that takes a long time. With CAMEO, it took only a small fraction of the usual number of measurements to home in on the best material.

The AI is also designed to contain knowledge of key principles, including knowledge of past simulations and lab experiments, how the equipment works, and physical concepts. For example, the researchers armed CAMEO with the knowledge of phase mapping, which describes how the arrangement of atoms in a material changes with chemical composition and temperature.

Understanding how atoms are arranged in a material is important in determining its properties such as how hard or how electrically insulating it is, and how well it is suited for a specific application.

"The AI is unsupervised. Many types of AI need to be trained or supervised. Instead of asking it to learn physical laws, we encode them into the AI. You don't need a human to train the AI," said Kusne.

One of the best ways to figure out the structure of a material is by bombarding it with X-rays, in a technique called X-ray diffraction. By identifying the angles at which the X-rays bounce off, scientists can determine how atoms are arranged in a material, enabling them to figure out its crystal structure. However, a single in-house X-ray diffraction experiment can take an hour or more. At a synchrotron facility where a large machine the size of a football field accelerates electrically charged particles at close to the speed of light, this process can take 10 seconds because the fast-moving particles emit large numbers of X-rays. This is the method used in the experiments, which were performed at the Stanford Synchrotron Radiation Lightsource (SSRL).



Credit: CC0 Public Domain



The algorithm is installed on a computer that connects to the X-ray diffraction equipment over a data network. CAMEO decides which material composition to study next by choosing which material the X-rays focus on to investigate its atomic structure. With each new iteration, CAMEO learns from past measurements and identifies the next material to study. This allows the AI to explore how a material's composition affects its structure and identify the best material for the task.

"Think of this process as trying to make the perfect cake," Kusne said. "You're mixing different types of ingredients, flour, eggs, or butter, using a variety of recipes to make the best cake." With the AI, it's searching through the "recipes" or experiments to determine the best composition for the material.

That approach is how CAMEO discovered the material  $\text{Ge}_{0.4}\text{Sb}_{0.6}\text{Te}_{0.7}$ , which the group shortened to GST467. CAMEO was given 177 potential materials to investigate, covering a large range of compositional recipes. To arrive at this material, CAMEO performed 19 different experimental cycles, which took 10 hours, compared with the estimated 90 hours it would have taken a scientist with the full set of 177 materials.

### **The New Material**

The material is composed of three different elements (germanium, antimony and tellurium, Ge-Sb-Te) and is a phase-change memory material, that is, it changes its atomic structure from crystalline (solid material with atoms in designated, regular positions) to amorphous (solid material with atoms in random positions) when quickly melted by applying heat. This type of material is used in electronic memory applications such as data storage. Although there are infinite composition variations possible in the Ge-Sb-Te alloy system, the new material GST467 discovered by CAMEO is optimal for phase-change applications.

Researchers wanted CAMEO to find the best Ge-Sb-Te alloy, one that had the largest difference in "optical contrast" between the crystalline and amorphous states. On a DVD or Blu-ray disc, for example, optical contrast allows a scanning laser to read the disc by distinguishing between regions that have high or low reflectivity. They found that GST467 has twice the optical contrast of  $\text{Ge}_{0.2}\text{Sb}_{0.2}\text{Te}_{0.5}$ , a well-known material that's commonly used for DVDs. The larger contrast enables the new material to outperform the old material by a significant margin.

GST467 also has applications for photonic switching devices, which control the direction of light in a circuit. They can also be applied in neuromorphic computing, a field of study focused on developing devices that emulate the structure and function of neurons in the brain, opening possibilities for new kinds of computers as well as other applications such as extracting useful data from complex images.

### **CAMEO's Wider Applications**

The researchers believe CAMEO can be used for many other materials applications. The code for CAMEO is open source and will be freely available for use by scientists and researchers. And unlike similar machine-learning approaches, CAMEO discovered a useful new compound by focusing on the composition-structure-property relationship of crystalline materials. In this way, the algorithm navigated the course of discovery by tracking the structural origins of a material's functions.

One benefit of CAMEO is minimizing costs, since proposing, planning and running experiments at synchrotron facilities requires time and money. Researchers estimate a tenfold reduction in time for experiments using CAMEO, since the number of experiments performed can be cut by one tenth. Because the AI is running the measurements, collecting data and performing the analysis, this also reduces the amount of knowledge a researcher needs to run the experiment. All the researcher must focus on is running the AI.

Another benefit is providing the ability for scientists to work remotely. "This opens up a wave of scientists to still work and be productive without actually being in the lab," said Apurva Mehta, a researcher at the SLAC National Accelerator Laboratory. This could mean that if scientists wanted to work on research involving contagious diseases or viruses, such as COVID-19, they could do so safely and remotely while relying on the AI to conduct the experiments in the lab.

For now, researchers will continue to improve the AI and try to make the algorithms capable of solving ever more complex problems. "CAMEO has the intelligence of a robot scientist, and it's built to design, run and learn from experiments in a very efficient way," said Kusne.

**More information:** *Nature Communications* (2020). [DOI: 10.1038/s41467-020-19597-w](https://doi.org/10.1038/s41467-020-19597-w)

**Journal information:** *Nature Communications*

<https://phys.org/news/2020-11-ai-algorithm-compound-potentially-photonic.html>

## COVID-19 Research News



Wed, 25 Nov 2020

### Dogs can sniff COVID-19 infection before symptoms set in, research suggests

*During the International K9 Team online workshop, it was revealed that the dogs in Finland and Lebanon were able to detect COVID-19 infection days before conventional tests could. This could mean that canines have the ability to detect spot infection much before symptoms start*

Several studies conducted since the outbreak of the coronavirus pandemic have suggested that dogs can sniff out the novel coronavirus to perfect accuracy. Scientists say that the superior sense of smell of canines may even aid in containing the spread of the deadly disease that has infected millions worldwide.

Trials are presently being conducted at airports in the United Arab Emirates, Finland, and Lebanon. Sniffer dogs stationed at these airports were being used to detect COVID-19 in sweat samples of passengers.

During the November 3 International K9 Team online workshop, it was revealed that the dogs in Finland and Lebanon were able to detect COVID-19 infection days before conventional tests could. This could mean that canines have the ability to detect spot infection much before symptoms start.

Riad Sarkis, a surgeon who is a part of one such training programme, said two sniffer dogs stationed at Lebanon airport screened 1,680 passengers and detected 158 COVID-19 infections that were later confirmed by RT-PCR tests. The dogs reportedly identified 92 percent of the COVID-19 positive cases.

A study titled 'Scent dog identification of samples from COVID-19 patients', published on July 23, had stated that "volatile organic compounds produced during respiratory infections can cause specific scent imprints, which can be detected by trained dogs with a high rate of precision."

Several other studies have also suggested the same, but none of these have been peer reviewed. So, dogs are still not being used to carry out the task. However, canines are being trained across the world based on the study findings, so that they can aid in coronavirus detection efforts in the future.

According to a *Nature.com* report, scientists involved in the training have said that dogs could come of great help in detecting COVID-19 positive persons at busy public places. They would reportedly be able to screen hundreds of human beings per hour at busy areas such as airports and



Image: Antti Aimo-Koivisto/Lehtikuva via AP

Image: Antti Aimo-Koivisto/Lehtikuva via AP

markets. Not only would the process be fast, but also cheaper than most other techniques that involve the usage of complex machines and kits.

However, veterinary neurologist Holger Volk, who is leading an effort to train and study coronavirus-sniffing canines, said this does not mean dogs can replace RT-PCR machines in the future. He said: "No one is saying they can replace a PCR machine, but they could be very promising."

<https://www.moneycontrol.com/news/science/dogs-can-sniff-covid-19-infection-before-symptoms-set-in-research-suggests-6152381.html>

## BusinessLine

Wed, 25 Nov 2020

# Blood clot linked to severe Covid-19 infection and deaths, reveals study

*By Prashasti Awasthi*

Mumbai: New research suggested that the COVID-19 infection is linked to hypercoagulability or the increased tendency of the blood to clot.

The study published in the journal *EClinical Medicine* by *The Lancet*. It found that blood clots led to an increased risk of death by 74 per cent.

The study was led by researchers from UC San Diego Health. For the study, the researchers reviewed 42 different studies involving more than 8,000 patients diagnosed with COVID-19.

Using random models, the team produced summary rates and odds ratios of mortality in COVID-19 patients with thromboembolism, blood clots. They then compared them to patients without these conditions to determine what effect blood clots may have on the risk of death.

Lead author, Mahmoud Malas, MD, division chief of Vascular and Endovascular Surgery at UC San Diego Health said: "We began to notice a really unusual manifestation of venous and arterial thromboembolism in patients with COVID-19."

Malas added: "In addition to higher instances of blood clots, the mortality for patients hospitalized for COVID-19 and with thromboembolism was much higher, compared to patients without clots. It's unusual because we have never seen anything like this with other respiratory infections."

The study noted that overall, 20 per cent of the COVID-19 patients were found to have blood clots in the veins. This gets increased for patients who are admitted to the intensive care unit. That statistic increased to 31 per cent.

The authors of the study explained that blood clots in the vein can reach the lungs and develop into a pulmonary embolism, resulting in a higher risk of death. Furthermore, blood clots in the arteries may lead to limb amputation if not treated surgically in time.

"The collective experience in the literature as captured in this meta-analysis study brings additional light on the importance of blood vessel clotting events in hospitalized patients with COVID-19," said Bryan Clary, MD, surgeon-in-chief at UC San Diego Health and co-author of the study. He added: "While the frequency of these events is much higher than expected, our study likely underestimates the incidence of thromboembolism in the global population of patients with COVID-19, including non-hospitalized patients."

According to Malas, the rate of clotting in COVID-19 patients is higher than what is reported for other viral pandemics, including the H1N1 influenza of 2009.

The researchers mentioned that for coronavirus patients, blood clots can appear in either veins or arteries. Now, clinical trials are being conducted to understand how blood thinners can mitigate the risk of clotting in patients with COVID-19.

Malas concluded: "What we can learn from this paper is due diligence. We're still in the process of understanding the pathophysiology of COVID-19, so it's important to have a low index of suspicion when it comes to this infection to ensure we're doing all we can to mitigate the spread and prevent severe outcomes."

<https://www.thehindubusinessline.com/news/science/blood-clot-linked-to-severe-covid-19-infection-and-deaths-reveals-study/article33168064.ece>



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## **Pfizer's Covid-19 vaccine may not be needed, says Harsh Vardhan**

*India already has at least five vaccine candidates against Covid-19 under human trial, of which three vaccine candidates are undergoing advanced phase 2/3 clinical trials*

*Edited By Zara Khan*

New Delhi: Union health minister Harsh Vardhan has reiterated that India may not require Pfizer's vaccine against coronavirus disease (Covid-19), with other vaccine candidates being tested in the country showing promising results in safety trials so far.

According to media reports, the health minister said that it did not make sense to consider the Pfizer-BioNTech's vaccine as even the US regulatory authority had not yet granted approval to the vaccine. And even if the approvals are granted, the manufacturer would first attempt to cater to its local population before supplying the vaccine to other countries, he said.

India has at least five vaccine candidates against Covid-19 under human trial, of which three vaccine candidates are undergoing advanced phase 2/3 clinical trials to establish safety and efficacy.

The Serum Institute of India is conducting the phase 3 trial with the Indian Council of Medical Research (ICMR) for the Oxford-AstraZeneca vaccine candidate.

The Bharat Biotech-ICMR vaccine candidate, Covaxin, has also progressed, and phase 3 trial has started. The results of its phase 2 trials are expected anytime now.

Cadila Health's vaccine candidate, ZyCovD, has also completed the phase 2 trial, and is awaiting results, even as the follow up period is nearing its end.

Apart from these three, phase 2/3 trials for the Sputnik V Russian vaccine, for which India's Dr Reddy's labs has tied up with the Russian vaccine developers, is going to start anytime this week.

Hyderabad-based Biological E's vaccine candidate also has early phase 1/2 trials in the pipeline.

The government is in talks with developers and manufacturers of all potential Covid-19 vaccine candidates for procurement of their product. According to the health minister, the government will start the immunisation process in a phased manner. In the first phase it is looking at vaccinating 250-300 million people by July of next year, for which it aims to procure around 500 million vaccine doses as most vaccines follow a two-dose regimen.

"As for following up on the progress made on vaccine research, the government is continuously in talks with the parties involved. However, the actual procurement process will begin the day any of these vaccines gets regulatory approvals. So far, none of these vaccines has secured emergency use authorization (EUA) so there is no question yet of vaccine procurement," Union health secretary, Rajesh Bhushan, told HT.

<https://www.hindustantimes.com/health/pfizer-s-covid-19-vaccine-may-not-be-needed-says-harsh-varadhan/story-n9tHgSR7pvUsrpvzWA57BP.html>

