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Wed, 11 Nov 2020

Gaganyaan Unplugged-7: ADRDE recovery system to play critical role during India's manned mission

Bengaluru: The most-awaited final stage of any manned space mission is the safe landing of astronauts returning to earth.

In Gaganyaan, India's manned Human Spaceflight Programme (HSP), this extremely critical event will be executed by home-grown parachutes made by the Agra-based Aerial Delivery Research and Development Establishment (ADRDE).

One of the silent wings of the Defence Research and Development Organisation, ADRDE has been tasked with ensuring that our astronauts waft to a safe and soft landing.

In this edition of Gaganyaan Unplugged, the seventh in the series, we look at ADRDE's efforts at developing a parachute system for the smooth landing of the space capsule carrying Indian astronauts back on earth.

ADRDE began work on developing recovery systems for Gaganyaan in 2008 with the conceptual design. Prior to this, scientists there had developed a recovery parachute system for Space Recovery Experiment (SRE) of 600-kg class payload.

The experiment was conducted by the Indian Space Research Organisation (ISRO), and the payload was successfully recovered from space in 2007.

Speaking to Onmanorama on the challenges of developing such products, an official said the scientists had to start from scratch as not much literature or similar systems were available for benchmarking.

"The crew module of HSP is a heavy weight four-tonne weight class re-entry payload carrying crew onboard. The challenges involved in the parachute system are manifold. High strength-to-weight ratio as well as minimum packing volume of the parachute systems is of utmost importance," the official said.

Rigorous Testing

Ahead of the trials, the recovery systems were put through rigorous testing for qualification at different levels. This included testing of raw material of different textiles and their fabrication, integration, testing in high speed dynamic conditions, aerial drop test simulation from military aircraft, system-level test from helicopter and system evaluation at 20-30% higher loading conditions.

"Challenges also involved mathematical modelling of G-shock due to parachute deployment, its effect on crew and simulation of window timings/event marking for each operation. All associated parameters are interlinked scientifically and logistically. Meticulous auditing of the effect of change of one parameter on other parameters is extremely critical with respect to flight trajectory and safety margins," the official said.

With parachutes being flexible structures, instrumentation of such systems for their performance evaluation was a huge challenge for the scientists. The iterative processes for the different kinds of technical textile items — both in terms of physical as well as performance parameters — are critically examined by senior scientists and experts from DRDO, ISRO, IITs and other reputed engineering institutions.

Tests Continue

After all sub-system level qualification tests conducted by transport aircraft and Rail Track Rocket Sled (RTRS), the parachute system was tested in simulated environment using helicopter, and real-time environment during Crew Module Atmospheric Re-entry Experiment (CARE) in which the unmanned module was taken up to 126 km altitude (close to low earth orbit) and brought back to earth's surface safely by the parachute system on December 18, 2014.

The upcoming unmanned mission of Gaganyaan (5,000 kg weight class module) will be incorporated with the parachute system of ADRDE, which will recover the space module safely after re-entry, from 7 km altitude to sea level. This will be a precursor to the manned mission.

"During the manned mission as well, the parachute system will be used for safe recovery of the crew module after completion of the mission. The parachute system will also recover the crew module in case of any abort or emergency," said the official.

Key Features

Aerial delivery systems are basically textile-based decelerators used in applications such as parachutes for paratroopers, for precision delivery of loads, paradrop of heavy loads, as aircraft brake parachutes, for armament delivery, UAV recovery and space module recovery. Following are some of the key features of ADRDE parachutes:

- Light-weight, flexible and high-drag-producing device
- Compact, can be folded to a less volume
- Highly reliable
- Can be designed to suit the system requirement
- Technical Textiles

Aerial delivery systems are made of technical textiles. Various types of textile materials in the form of woven fabric, tapes/webbings, cordages and threads are used as per the requirement of the system.

All textile materials are tested before fabrication as per the specification. The qualification test plans are prepared as per the system requirement in consultation with CEMILAC (Centre for Military Airworthiness & Certification).

The system should pass the qualification tests pertaining to its deployment, structure, deceleration capability, stability and reusability.

Asked if India is seeking any external help in designing these products, the official said the delivery systems are completely desi. "No external help is sought from any country. All aerial delivery systems are being designed and developed within the competency of the country. We have enough expertise in this field now," the official said.

On the roles of academic institutions in developing the systems, the official said the parachute/payload models are being tested in NWTf IIT Kanpur for design verification. A few consultancy research works are being done at IITs and other academia with respect to modelling and simulation.

At ADRDE, a 20-25 member team is working on the Gaganyaan mission alone.

In the last one decade, ADRDE has developed brake and pilot parachutes for most of the fighter aircraft in the inventory of the IAF. In addition, various types of paratroopers' parachutes have been developed for the armed forces.

Among the key products developed so far are heavy drop systems of various capacity for paradrop of heavy loads in plains, desert and high-altitude areas, recovery system for space capsule

SRE for ISRO, recovery system of Lakshya and Nishant UAVs, various armament delivery systems, autonomous controlled delivery systems, aerial surveillance systems and aircraft arrester barrier systems (AABS).

For ADRDE, the Gaganyaan mission poses multiple challenges, considering the complexities involved. Yet, despite the pandemic pause, the scientists are confident of delivering the systems for the next set of trials, banking on their rich expertise in this domain.

(The writer is an independent aerospace and defence journalist, who blogs at Tarmak007 and tweets @writetake.)

<https://www.onmanorama.com/news/nation/2020/11/10/gaganyaan-unplugged-adrde-recovery-system-manned-space-mission-india.html>



Wed, 11 Nov 2020

After enhanced version of Pinaka Mk-1, development of Guided Pinaka nears completion

In the conventional battle space, long-range artillery systems like Pinaka are used for attacking adversary targets prior to close-quarter battles, which involve smaller-range artillery, armoured elements and the infantry

By Sushant Kulkarni

Pune: From the announcement of raising its six regiments in August to the successful test of Enhanced Pinaka Mk-1 last week, a lot has happened in the long-running development of Pinaka rocket systems and its upgrades. Now, the development of the Guided version of Pinaka, with almost double the original range, is nearing completion, said an official of the Defence Research and Development Organisation (DRDO).

In the conventional battle space, long-range artillery systems like Pinaka are used for attacking adversary targets prior to close-quarter battles, which involve smaller-range artillery, armoured elements and the infantry.

The DRDO started developing Pinaka in the late 1980s, as an alternative to the multi-barrel rocket launching systems of Russian make, called the 'Grad' and 'Smerch', which are still in use. After successful tests of Pinaka Mark-1 in the late 1990s, it was successfully used during the 1999 Kargil war. Over the next few years, multiple regiments of the system came up along India's border areas with China and Pakistan.



The Pinaka multiple launch rocket system has been designed and developed indigenously by the Defence Research and Development Organisation. (File)

The Pinaka, which is primarily a multi-barrel rocket system (MBRL) system, can fire a salvo of 12 rockets over a period of 44 seconds. One battery of Pinaka system consists of six launch vehicles, accompanied by the loader system, radar and links with network-based systems, and a command post. One battery can neutralise an area of one km by one km.

In the last week of August, in a step towards enhancing long-range artillery capabilities, the MoD announced acquisition of six Pinaka Regiments for the Regiment of Artillery of the Indian Army at an approximate cost of Rs 2,580 crore. At the time, the acquisition wing of MoD signed contracts with public sector entity Bharat Earth Movers Ltd and private players Tata Power Company Ltd (TPCL) and Larsen & Toubro (L&T).

These six Pinaka regiments, whose induction would be completed by 2014, would eventually comprise 114 launchers with Automated Gun Aiming and Positioning System (AGAPS) and 45

Command Posts, to be procured from TPCL and L&T, and 330 vehicles, to be procured from BEML. These six Pinaka Regiments will be operationalised along the northern and eastern Borders of our country.

In the last week of September, the Authority Holding Sealed Particulars (AHSP) of Pinaka rocket systems were handed over by the DRDO to the Directorate General of Quality Assurance (DGQA) of the MoD. The AHSP transfer marks successful streamlining of production processes of Pinaka rockets, its launchers, battery command posts, loader-cum-replenishment and replenishment vehicles, as well as successful establishment of Quality Assurance processes.

While these developments were about the Pinaka Mk-1, which has a range of 38 km, the DRDO has also developed an enhanced version of Mark-1, tested on Wednesday, which has a range of 45 km and some key additional features. These rockets have been manufactured by M/s Economic Explosives Limited, a private sector entity based in Nagpur, to whom the technology has been transferred.

DRDO has also developed and successfully tested Mk-II and the guided variants of the Pinaka, which has a range of around 60 km, while the Guided Pinaka system has a range of 75 km and has integrated navigation, control and guidance system to improve the end accuracy and enhance the range. The navigation system of Guided Pinaka missile is also aided by the Indian Regional Navigation Satellite System (IRNSS).

In March and December 2019, the DRDO had conducted multiple successful tests of Guided Pinaka. The development of Guided Pinaka is near completion, a senior scientist with the DRDO told The Indian Express. DRDO scientists said that initially, the Guided Pinaka has undergone ground-level trials for the evaluation of the propulsion. Once those parameters were met, the instrumental flight trials were conducted. In the penultimate stage before the user trials, field tests in Pokhran were conducted in March and December 2019.

Highlighting the importance of Guided Pinaka, a DRDO scientist said that it will mainly avoid any possible collateral damage. The Pinaka rocket system has been developed to nullify a particular area, and the Guided version is its evolution from a rocket to a missile system. As per a set pattern of trials, the development has been following a path of internal trials, then user-assisted technical trials and then user trials.

In the future, the Pinaka Mk-1, enhanced Mk-1 and the Guided Pinaka will coexist in the Army's inventory, in the proportion that the Army wants. Pinaka will continue as a weapon that can destroy an area and the guided version will add an edge to it when a specific target has to be hit.

<https://indianexpress.com/article/india/after-enhanced-version-of-pinaka-mk-1-development-of-guided-pinaka-nears-completion-7046526/>



Wed, 11 Nov 2020

Is Indian anti tank missile more powerful than Israel's Spike?

The test shot was carried out on October 23 at the test site of the Pokhran field field, in the western state of Rajasthan. The missile destroyed the target with extremely high accuracy in both desert terrain and rugged frontier hills.

“This is the final test and the NAG program will begin to be deployed to all units in the military,” the Indian Defense Ministry said in a statement.

NAG is a product of the Defence Research and Development Organisation Agency of India (DRDO). The missile equipped with an advanced passive navigation system with the ability to precisely destroy the target. It is designed to destroy modern tanks and heavy armored targets. It also has night strike capabilities.

The missile can be launched from a ground-based launch pad or an airbase. The ground version can now be mounted on NAMICA (BMP-2 platform) using NAG missiles. The platform can fire six missiles with a gap of 20 seconds.

The NAG was developed under the Indian Integrated Guided Missile Development Program (IGMDP) program developed by the Ministry of Defense, involving four other types of missiles, including Agni, Akash, Trishul, and Prithvi.

The first test of the NAG was carried out in October 1990, but it was not until 2002 that there were initial successes. Testing of anti-tank NAG missiles against stationary and mobile targets took place from 2007 to 2016.

During the test in January 2016, a NAG missile successfully destroyed a thermal weapons system (TTS) at a range of 4 km at the Pokhran range. This anti-tank missile has undergone the last of the practical tests in different weather conditions this year.

According to DRDO, NAG is a line of anti-armored weapon guided missiles built of lightweight and highly durable composite materials. It has a high combat ability and can evade the enemy's defenses.

The missile is installed with 4 penguins, spread and length 1.85, diameter 0.20m, wingspan of 0.4m and weighs 43kg. The missile is fitted with a targeting guidance system, while the middle body contains many compact sensors and warheads.

<https://www.defenceaviationpost.com/2020/11/is-indian-anti-tank-missile-more-powerful-than-israels-spike/>



Defence Strategic: National/International

THE  HINDU

Wed, 11 Nov 2020

Adversaries may take advantage if we do not have strong armed forces: Gen. Bipin Rawat

The Chief of Defence Staff was speaking at the inaugural session of the fifth annual conclave of the Bharatshakti.in, a portal on defence and military issues

New Delhi: The Indian armed forces are operating in a very complex, and uncertain environment and they must continue to enhance capabilities for peace in the region as India's adversaries may take advantage if its military power is not strong, Chief of Defence Staff Gen. Bipin Rawat said on Tuesday.

He also said that India wants to share its military capabilities with friendly countries in the neighbourhood and the extended neighbourhood as well as to those who need its support.

The Chief of Defence Staff was speaking at the inaugural session of the fifth annual conclave of the *Bharatshakti.in*, a portal on defence and military issues.

"We are today operating in a very complex, uncertain and a very volatile environment. There are small and big battles raging nearly in every region of the world. Therefore, we all need strong armed forces if we have to defend ourselves, defend our nation, defend the integrity of our nation and the safety and security of our people," Gen. Rawat said.

"But, then are we saying that armed forces must prepare for war? No. The armed forces must develop capabilities to bring about peace in the region. If we do not have strong armed forces, the adversary will take advantage of us," he said.

Gen. Rawat's comments came in the midst of an over six-month border standoff between India and China in eastern Ladakh that has significantly strained their ties. Both sides held a series of diplomatic and military talks to resolve the row. However, no concrete breakthrough has been achieved to end the standoff.

In a message, which was read out at the conclave, Prime Minister Narendra Modi cited various reform initiatives rolled out by the government in the defence sector to produce modern equipment and harness new technology as well as to infuse better synergy among the armed forces.

"We are marching ahead with the nation's collective resolve to build a modern and self-reliant India. Our resoluteness gets reflected in an unprecedented spirit of self-confidence in the defence sector today," Mr. Modi said.

The Prime Minister said a self-reliant India is a "win-win resolve" for all the stakeholders, as this vision is for world peace and a resilient global economy.



Chief of Defence Staff (CDS) General Bipin Rawat. File | Photo Credit: PTI

“From private and public sectors to foreign partners, all would get strength from India’s vibrant strategic ecosystem,” he said.

In his address, Gen. Rawat also spoke about challenges being faced by the armed forces operating in difficult challenging environments including in jungles, deserts and terrains ranging from 6000 to 6500 metres in altitude.

“Our navy operates in Indo-Pacific, an area which witnesses the largest concentration of white shipping. They have to develop technologies not only to operate on the surface but below the surface of the ocean as well in an environment which is becoming increasingly complex,” the Chief of Defence Staff said.

He said the Indian armed forces need capabilities that no other armed forces in the world will perhaps require due to varied challenges and environment. Therefore, Gen. Rawat said, the kind of technology India is developing and the weapons systems that can find their way into the Indian inventory will be second to none.

“We are not hesitant in inviting foreign collaborators who can support our industry, hand-hold them and move on...We also want to share the capabilities with the other armed forces around the globe, particularly in the neighbourhood and extended neighbourhood,” Gen. Rawat said.

“We are willing to support those who need our support, especially those nations which are also going through troubled times and looking at good weapons systems,” he said in the presence of defence officials of several foreign countries.

Chief of Air Staff Air Chief Marshal R.K.S. Bhadauria said the threat by India’s adversaries is ‘deep and long term’.

<https://www.thehindu.com/news/national/adversaries-may-take-advantage-if-we-do-not-have-strong-armed-forces-gen-bipin-rawat/article33065598.ece>

Outlook

Wed, 11 Nov 2020

Hopeful of de-escalation of tension in eastern Ladakh: Army Chief M M Navarane

New Delhi: Army Chief general M M Naravane on Tuesday said that he was hopeful that the Indian and Chinese militaries will be able to reach an agreement on disengagement and de-escalation of tension in eastern Ladakh.

In an address at a seminar, the army Chief said senior military commanders of India and China are holding talks to iron out modalities for deescalation of tension in eastern Ladakh.

"We are hopeful of reaching an agreement which is mutually acceptable and is really beneficial in keeping with the overarching policy guidelines," he said.

The chief of Army staff also said that the situation in eastern Ladakh is quite stable.

General Naravane was speaking at a conclave organised by Bharatshakti.in, a portal on defence and military issues.

Referring to Indian troops deployed in the high-altitude region, he said they are equipped with appropriate clothing and weapons, and added that there is no shortage whatsoever.

India and China are likely to hold another round of military talks to discuss specific proposals for a possible breakthrough in the long-negotiated disengagement process in eastern Ladakh.

The eighth round of Corps Commander-level talks on Friday had broadly discussed disengagement of troops from specific friction points and both sides would like to take forward the "constructive" dialogue to the next round with detailed deliberations, sources had said.

In a joint statement released earlier on Friday, the Indian Army and the Chinese People's Liberation Army (PLA) described the talks as candid, in-depth and constructive.

The statement said it was agreed to earnestly implement the important consensus reached by the leaders of the two countries and ensure that the frontline troops exercise restraint and avoid misunderstanding and miscalculation.

Nearly 50,000 troops of the Indian Army are currently deployed in a high state of combat readiness in various mountainous locations in eastern Ladakh in sub-zero conditions as multiple rounds of talks between the two sides have not yielded any concrete outcome yet to resolve the standoff.

China has also deployed an equal number of troops, according to officials. The standoff between the two sides erupted in early May.

(Disclaimer: This story has not been edited by Outlook staff and is auto-generated from news agency feeds. Source: PTI)

<https://www.outlookindia.com/newscroll/hopeful-of-deescalation-of-tension-in-eastern-ladakh-army-chief-m-m-navarane/1974026>



Wed, 11 Nov 2020

Why Indian Air Force needs this 4th-Gen Jet than can even outgun A 5th-Gen Aircraft like F-35s & Su-57s?

By Mansij Asthana

With the complete dynamic within the United States shifting with the election of Joe Biden as the 46th President, China is likelier to breathe a sigh of relief now than if President Donald Trump, who has been a constant thorn in their side, was to be re-elected.

With Biden's ascendancy to the throne, there is a higher scope of there being increased cooperation between the two nations than under the Trump administration, thereby also affecting the state of things in India, who has been caught in a potential war-like situation with neighbors China at the Line of Actual Control (LAC) de facto in Eastern Ladakh.

A potential change of policy between Washington and Beijing calls rings a warning bell for India to bolster their defensive options and Modi would be wise to fast-forward their acquisition process of additional modern fighter jets under their proposed Medium Multi-Role Combat Aircraft (MMRCA) 2.0 contract.



Now, with the likes of modern fourth-generation fighter jets like SAAB's Gripen, Lockheed Martin's F-16, Eurofighter Typhoons, and Boeing's F-15 and F-18 Super Hornets thrown into the mix, there is a reason why India should rather take another set towards enhancing their cooperation with Russia and seriously consider the world's best dogfighter – the Sukhoi Su-35 fighters.

The 4.5 generation Su-35 remains Russia's best air superiority fighter and a fierce competitor against most of its Western counterparts despite being introduced more than a decade back.

The single-seat, twin-engine, supermaneuverable Su-35 aircraft is the designation for two improved derivatives of the Su-27 air-defense fighter exhibits a number of striking design features that set it apart from other jets under the same bracket.

The fighter is powered by the Saturn AL-41F1S engines which support supercruising or the ability to sustain supersonic flight without the use of afterburners. The canards in the Su-35 are replaced by thrust vectoring nozzles, which enable it to offer impressive maneuverability gains in dogfighting scenarios.

With India already boasting the French Rafales in their squadrons, the Su-35 will add that much-needed steel in the IAF's dogfighting abilities with a combination of the two fighters proving to be a deadly scenario for any of the Chinese or Pakistani fighter jets.

Moreover, with China already equipped with the Su-35 fighters, they are fully aware of the abilities of the Russian jets, which means that New Delhi will be able to boast two different proven fighters in their air fleet, who are more than equipped in dealing with unproven variants of different indigenous Chinese fighter jets.

The Su-35 with its advanced avionics and counterattacking abilities could give New Delhi an upper hand in a potential clash with the Chinese Air Force (PLAAF).

According to Mark Episkopos, National Security Reporter for the National Interest – “The Su-35S shipped with a major avionics overhaul, including a digital fly-by-wire flight control system, the IRBIS-E phased array radar and an onboard infrared search and track (IRST) system.

No less important for its air superiority role, the Su-35 boasts an offensive electronic countermeasures (ECM) suite that can feasibly jam the F-16's AIM-120 AMRAAM and similar air-to-air missiles.”

On the other hand, the Su-57 will offer India with one feature which other fighters under the 4.5 generation bracket do not provide, which is stealth technology. One must also note that most nations are now focusing on Electronic Warfare Systems (EWS) over stealth as they consider the EWS most important part of sixth-generation jets, besides laser weapons (DEWs).

“The new Su-57—with some relatively minor avionics upgrades such a new active electronically scanned array antenna a new L-band array for its Su-35-derived Byelka radar suite—offers similar sensor and weapons capabilities as its predecessors. Even the Su-57's current 32,500lb thrust class Saturn AL-41F1 afterburning engines are derivatives of the Su-35's /AL-41F1S engines,” said Episkopos.

Moreover, the Su-35 has an even better payload than the stealth American exclusive F-22 Raptors, which are without a doubt considered the most advanced fighters on the planet, so much so that the US has a law in place to ban its sale to any foreign country.

The Su-35 boasts an expansive weapons suite spread across a whopping 12 hardpoints, with their improved R-74 short-range air-to-air missile having an impressive range between 25 to 30 miles, while also supporting off-boresight fire.

The Russian Air Force currently has around 115 serial Su-35's in service with more than 50 fighters having been ordered through recent export deals with partners including China and Egypt. Indonesia is the latest region to be linked with a deal for buying the prestigious fighters having backed off earlier.

According to a US Air Force official who had experience on the F-35s says that Su-35 could pose a serious challenge to their American counterparts, as the F-35 does not have the sheer speed or altitude capability of the Su-35.

“Why do we need American F-16s if we can easily buy Russian Su-35s, which are even more deadly than the F-35s? We did everything we could, but the Americans refused to sell their planes to us – now it's Washington's problem” – Indonesian Ambassador to the US

Fu Qianshao, a Chinese air defense expert, while speaking to the Global Times has called the Su-35s one of the best fourth-generation fighters on the planet and has said that China will look to acquire more.

“China could indeed buy more Su-35s, they are not meant to replace older Chinese jets because the Russian aircraft is too expensive and China has too many old jets. The replacement will most likely be done by domestically made warplanes.”

<https://eurasianimes.com/why-indian-must-consider-this-4th-gen-aircraft-than-even-outguns-both-5th-gen-stealthy-f-35-su-57-jets/>

THE ECONOMIC TIMES

Wed, 11 Nov 2020

Military court asks government to hike Major General-rank officer's salary

Synopsis

Air Vice-Marshal P Subhash Babu had approached the Armed Forces Tribunal through counsel Ankur Chhibber against the anomaly which has come up after the implementation of the Sixth pay Commission where senior Colonels and Brigadiers get more pay than the Major Generals as they get military service pay while the latter do not get it.

New Delhi: In a significant decision, which might pave the way for hiking salaries of Major General-rank officers in the defence services who are getting lesser pay than their juniors, the Armed Forces Tribunal has directed the government to increase the pay of an Air Vice-Marshal of the Indian Air Force (IAF).

Air Vice-Marshal P Subhash Babu had approached the Armed Forces Tribunal through counsel Ankur Chhibber against the anomaly which has come up after the implementation of the Sixth pay Commission where senior Colonels and Brigadiers get more pay than the Major Generals as they get military service pay while the latter do not get it.

"Respondents are directed to step-up the pay of the applicant retrospectively with effect from July 1, 2017, bringing it at par with his immediate juniors and thereafter grant all arrears of pay retrospectively with effect from July 1, 2017," the Tribunal said.

"The respondents are also directed to grant pension and other consequential benefits to the applicant with effect from July 1, 2020. The aforesaid directions be complied with within a period of three months from the date of receipt of the copy of this order, along with interest at 6 percent per annum from the date due till the payment of arrears," AFT Chairperson Rajendra Menon said in his judgment in the case.

Chhibber said that after the 6th Pay Commission it was decided the military service pay would only be payable up to the rank of brigadier and not beyond that.

"As a consequence, the two general stars salary became less than group captains, colonels' time scale and other juniors officers," he said.

Chhibber said the verdict by the AFT would help in addressing the long-pending grievance of the two-star officers of the armed forces.

"The honourable court has held the same to be back and has directed that the pay of the officer be upgraded to that of the junior officer and accordingly his pension will also be revised," he said.

The Defence Ministry had earlier rejected the statutory complaint filed by the AVM against the pay disparity.

While allowing the plea by the officer, the military court pulled up the Defence Ministry saying that "in rejecting the Statutory Complaint of the applicant without considering all these aspects, the respondents have committed grave irregularities and illegalities, accordingly, impugned order dated October 15, 2019, being unsustainable, is quashed."

In his plea, the officer had highlighted that as a Major General-rank officer, (Air Vice Marshal) his pay as on July 1, 2017, was Rs 2,18,200, whereas persons junior to him like two Air

Commodores, who were commissioned much after the applicant, were drawing pay with military service pay at Rs. 2,26,800 and Rs.2,20,600, respectively.

<https://economictimes.indiatimes.com/news/defence/military-court-asks-government-to-hike-major-general-rank-officers-salary/articleshow/79151011.cms>



Wed, 11 Nov 2020

सैलरी डिफरेंस पर अहम फैसला:मिलिट्री कोर्ट ने सरकार से कहा- एयर वाइस मार्शल का वेतन उसके जूनियर्स से कम, इसे बढ़ाइए

छठा वेतन आयोग लागू होने के बाद सैन्य अफसरों के वेतन में आई विसंगति पर आर्म्ड फोर्स ज ट्रिब्यूनल ने मंगलवार को अहम फैसला दिया। ट्रिब्यूनल ने सरकार को एयरफोर्स के एयर वाइस-मार्शल का वेतन बढ़ाने के निर्देश दिए हैं। इस फैसले से मेजर जनरल रैंक के अफसरों की तनखाह बढ़ने का रास्ता खुल सकता है।

एयर वाइस मार्शल पी. सुभाष बाबू ने छठे वेतन आयोग के लागू होने के बाद सामने आई विसंगति के खिलाफ ट्रिब्यूनल का दरवाजा खटखटाया था। उनके वकील अंकुर छिबबर ने दलील दी कि वरिष्ठ कर्नल और ब्रिगेडियर मेजर जनरलों की तुलना में ज्यादा वेतन पा रहे हैं। इसकी वजह उन्हें सैन्य सेवा वेतन मिलना है।

तीन महीने में किया जाए भुगतान

इस पर ट्रिब्यूनल ने सरकार को तत्काल प्रभाव से 1 जुलाई 2017 से याचिकाकर्ता को वेतन का भुगतान करने के लिए निर्देशित किया। इसके अलावा 1 जुलाई 2020 से आवेदक को पेंशन और अन्य लाभ देने के लिए भी कहा है। इन निर्देशों का अनुपालन आदेश की प्रति मिलने की तारीख से तीन महीने के अंदर किया जाएगा।

ट्रिब्यूनल के चेयरपर्सन राजेंद्र मेनन ने अपने फैसले में कहा कि बकाया राशि पर भुगतान करने की तारीख से 6 प्रतिशत सालाना ब्याज भी दिया जाए।

यह है पूरी कहानी

अधिकारी के वकील छिबबर ने कहा कि 6वें वेतन आयोग के बाद यह तय किया गया था कि सैन्य सेवा वेतन केवल ब्रिगेडियर के पद तक देय होगा, इससे आगे नहीं। इस कारण टू स्टार जनरल की सैलरी ग्रुप कैप्टन कर्नल से कम हो गई। उन्होंने कहा कि ट्रिब्यूनल का यह फैसला सशस्त्र बलों के टू स्टार ऑफिसर्स की लंबे समय से लंबित शिकायत को दूर करने में मदद करेगा। इसी हिसाब से उनकी पेंशन भी रिवाइज होगी।

याचिकाकर्ता ने दलील दी थी कि 1 जुलाई 2017 को एक मेजर जनरल-रैंक ऑफिसर (एयर वाइस मार्शल) के रूप में उनका वेतन 2,18,200 रुपये था। वहीं, उनसे काफी बाद में कमीशन लेने वाले दो एयर कमोडोर सैन्य सेवा वेतन के साथ 2,26,800 और 2,20,600 रुपये सैलरी ले रहे थे।

रक्षा मंत्रालय ने खारिज कर दी थी याचिका

इससे पहले रक्षा मंत्रालय ने वेतन असमानता के खिलाफ दायर शिकायत को खारिज कर दिया था। इसके बाद अधिकारी ने ट्रिब्यूनल में याचिका दायर की। इसे स्वीकार करते हुए मिलिट्री कोर्ट ने रक्षा मंत्रालय की खिंचाई की। ट्रिब्यूनल ने कहा कि सभी पहलुओं पर विचार किए बिना आवेदक की वैधानिक शिकायत को अस्वीकार करना गलत है।

<https://www.bhaskar.com/national/news/armed-forces-tribunal-on-government-over-indian-air-force-iaf-vice-marshal-pay-127901988.html>



Wed, 11 Nov 2020

Indian Navy craft to be given for port museum

Fast Attack Craft T 81 was commissioned into the Indian Navy in June 1999

Alappuzha: The Indian Navy has allotted a craft to the Alappuzha port museum being set up as part of the Heritage Project, Finance Minister T.M. Thomas Isaac has said.

“Vice Admiral G. Ashok Kumar, Vice Chief of the Naval Staff, informed that the Indian Naval Fast Attack Craft T 81 has been allotted to the Alappuzha port museum. The ship is in Mumbai. It will be handed over to the Southern Naval Command soon. From Kochi, we will have to bring it to Alappuzha and installed on the seashore in front of the museum. The Navy has offered full support,” Dr. Isaac said in a social media post. The Fast Attack Craft T 81 was commissioned into the Indian Navy in June 1999. The ship has a displacement of 60 tonnes, a length of 25 metres and a beam of five metres and is capable of speed in excess of 40 knots. It is capable of being put to sea in the shortest possible time and can perform a wide variety of roles including surveillance, reconnaissance, coordinated search and rescue operations and high-speed interception of small craft.

Dedicated section

Dr. Isaac said that the museum, being set up by renovating godowns close to the old port office, near the Alappuzha beach, would have a dedicated section for the Indian Navy.

Recently, Chief Minister Pinarayi Vijayan inaugurated the port museum building.

The museum will showcase the State’s rich maritime history, especially the story of the Alappuzha port.

<https://www.thehindu.com/news/national/kerala/indian-navy-craft-to-be-given-for-port-museum/article33069234.ece>

Significance of the resumption of Joint Commission on Bilateral Cooperation between India-Philippines: Move towards independent foreign policy

By SD Pradhan

The fourth meeting of the India-Philippines joint commission on bilateral cooperation, co-chaired by External Affairs Minister S Jaishankar and his Philippines counterpart Teodoro Locsin Jr. L, was held online on the 6th November was significant in several respects. First, this meeting took place after a gap of five years and this signifies the desire of both the countries to deepen defence relations. Second, this also suggests that the Philippines is now prepared to have an independent policy like prior to 2016. Third, this also indicates that the Philippines is coming out of the coercive control of China.

In this meeting the India and the Philippines resolved to strengthen defence relations and maritime cooperation, especially in military training. In addition, there was an agreement to cooperate in capacity building and expedite the process of procurement of defence equipment required by the Philippines. Both the foreign ministers comprehensively discussed various regional and bilateral matters of mutual importance as also the future trajectory of their engagement so as to ensure regular meetings. Both also stressed the need for cooperation to face the challenges arising from the pandemic and agreed to share relevant information on this issue on regular basis. They also agreed to work towards strengthening cooperation in agriculture, health and pharmaceuticals, tourism, energy, ICT and science and technology. They also agreed to explore closer cooperation in the emerging areas such as renewable energy, space, cyber security and traditional medicine. And significantly both reaffirmed their commitment to a multifaceted partnership in line with India's Indo-Pacific Oceans Initiative (IPOI) and the ASEAN's Outlook on Indo-Pacific to achieve shared security, prosperity and growth for all in the region.

The foundation for defence and security cooperation between the two countries had been laid in 2006, when the Memorandum of Agreement on Defence and Security was signed covering the following areas: 1) Defence Cooperation 2) Defence Technology Cooperation, and 3) Other Defence Related Activities. Some facets of the MOA on Defence and Security Cooperation have been implemented through the exchange visits of high government officials, friendly port visits of Indian warships to the Philippines and military training and education between Filipino and Indian military personnel. India and Philippines have an agreement for INTELLEX meetings for sharing and exchanging information on a range of sensitive issues. India and the Philippines have also formed a counter-terrorism group. Indian Navy and Coast Guard ships regularly visit the Philippines and hold consultations with their counterparts.

However, the movement on the agreement of 2006 was far from satisfactory. Hesitancy and lack of focus did not allow the full realisation of the potential of the relationship between the two countries. While the 1st Joint Defence Cooperation Committee met in 2012, the 2nd meeting took place in March 2017 after a lapse of five years. Though the Philippines side also observed in the above meeting that the India was keen in contributing to the Philippines defence capability building efforts as well as working with other its agencies to promote maritime domain awareness, yet the follow up was at the best tardy. On the side-lines of ASEAN forums, several meetings and exchange of visits took place, but there had been no significant political or defence related development.

While prior to 2016, India was moving closer to the Philippines, later the situation changed with

Duterte deciding to forge closer ties with China. In 2015, the then India's External Affairs Minister Late Mrs Sushma Swaraj mentioned the South China Sea as the 'West Philippines Sea' while interacting with her counterpart from the Philippines. India also supported the 2016 Ruling of the PCA immediately. However, with Duterte's decision to be in the Chinese fold, there was hardly any progress on developing closer relations between the two countries. In 2016, China pledged \$24 billion in aid and investment to the Philippines to win over the newly elected President. Under the influence of China, Duterte notified Washington in February 2020 of his intention to terminate the 21-year-old Visiting Forces Agreement with the United States, a pact that lets U.S. troops fluidly move in and out of the Philippines.

However, in June Duterte suspended that plan after witnessing that the aggressive Chinese activities were continuing unabated. Internally, several officers and political leaders had opposed Duterte's pro-China approach. There has been a realisation that an independent policy would serve best the country's interests. The Philippines has filed two diplomatic protests with China over the violations of international law and of the Philippines sovereignty in the West Philippine Sea. These suggest that the Philippines is trying to move out of the stifling control of China. The resumption of the 4th India-Philippines Joint Commission on Bilateral Cooperation after a gap of five years is yet another evidence.

The need for an independent foreign policy of the Philippines for the protection of the national core interests can hardly be over-emphasised. Duterte and his successors will have to appreciate the importance of rule-based system in the entire Indo-Pacific. The Philippines' support for this endeavour is important not only in its own interest but in the interest of all. The statement at the above meet by the Philippines Foreign Secretary is the right step. The Philippines should also give full support to the implementation of the PCA Ruling. Like Vietnam, Malaysia and Indonesia, it should also approach the UN for the implementation of the PCA Ruling. The Philippines may learn from the example of Vietnam, which pursued an independent foreign policy and was able to protect its national interests, while ensuring economic development by maintaining close relations with all the powers.

(Disclaimer: Views expressed above are the author's own.)

<https://timesofindia.indiatimes.com/blogs/ChanakyaCode/significance-of-the-resumption-of-joint-commission-on-bilateral-cooperation-between-india-philippines-move-towards-independent-foreign-policy/>

THE ECONOMIC TIMES

Wed, 11 Nov 2020

Italian defence & aerospace firms keen to explore joint production or technology transfer with India: Envoy

By Dipanjan Roy Chaudhury

Synopsis

As far as our cooperation in the multilateral arena is concerned, we have a very important opportunity in the next two years, as Italy and India will hold consecutive Presidencies of the G20. In this context, we committed to coordinate our activities and set common priorities to strengthen the impact and relevance of our legacy.

India's defence partnership with Italy, one of key European states and member of G-7, is being revived and got a major boost during Nov 6 Summit. Elaborating on achievements of the Summit, Italian envoy to India Vincenzo de Luca told ET's Dipanjan Roy Chaudhury that Italian defence firms are ready to explore possible avenues of cooperation in the field of joint production or

technology transfer. He also emphasised that Rome wants to foster a stronger cooperation between the Mediterranean and the Indian Ocean as part of its Indo-Pacific vision.

1. It was a landmark summit. 15 pacts and new areas of cooperation. What does it mean for Indo-Italy partnership.

The Virtual Summit between President Conte and Prime Minister Modi marks an important milestone in the bilateral relations between the two countries. The two leaders had a thorough exchange that ranged from global, regional and bilateral issues. They focused on further enhancing economic relations and strengthening cultural and scientific ties. The true added value of the meeting was the adoption of the Joint Declaration and the Plan of Action which contains the priority areas and strategic goals on which our bilateral partnership for the period 2020-2025 will be based upon. As far as our cooperation in the multilateral arena is concerned, we have a very important opportunity in the next two years, as Italy and India will hold consecutive Presidencies of the G20. In this context, we committed to coordinate our activities and set common priorities to strengthen the impact and relevance of our legacy.



The success of the 6 November Italy-India Virtual Summit is underpinned by the conclusion of 15 agreements. Some of those are in the defence industry sector.

2. The two PMs referred to Indo-Pacific partnership. What are Italy's plan for a Indo-Pacific strategy.

A sustainable economic recovery after the Covid crisis will be achieved only through the activation of solid and reliable global supply chains and enhanced connectivity. In this framework, the Indo-Pacific region will play a fundamental role, since through its sea-lanes a great deal of the world's trade and energy resources exchanges are operated. The Mediterranean Sea and the Indian Ocean overlap, connecting seamlessly Europe, Africa and Asia. For this reason, many actors are interested in ensuring that the connection among these regions is built on a rules-based international order, rule of law, sustainable and transparent infrastructure investment and freedom of navigation.

Last 9 September Italy became Development Partner of ASEAN with the purpose of contributing to any initiative aimed at facilitating the cooperation between Europe and the Indo-Pacific for the sake of stability, security and prosperity of all the countries concerned. Moreover, thanks also to the Indian support, Italy has recently joined the Indian Ocean Rim Association (IORA) as a Dialogue Partner. Again, our purpose is investing in the blue economy sector and foster a stronger cooperation between the Mediterranean and the Indian Ocean.

3. The Defence partnership is being revived. What are new areas including joint production in India in pipeline?

The success of the 6 November Italy-India Virtual Summit is underpinned by the conclusion of 15 agreements. Some of those are in the defence industry sector. In particular, our national champion in shipbuilding, Fincantieri, inked two MoUs with Cochin Shipyard Ltd on design, shipbuilding, manufacturing and repair/refit. There are also other Italian companies with world-class expertise that are already in partnership with Indian counterparts and there are others that are leaders in Aerospace, Defence and Security that would be ready to explore possible avenues of cooperation in the field of joint production or technology transfer.

4. How enthusiastic are Italian companies about Make in India program and increasing their investments here

The Make in India program opens many opportunities to Italian companies. There is a strong potential to further strengthen our economic relations and promote investments both ways. This was acknowledged also in the High Level Economic Dialogue at the level of CEOs that was held at the end of October, prior to the Summit. We need to encourage our "national champions" to interact between each other, unleash the untapped potential of our economic ties, and explore new

areas of cooperation, especially in high tech, green economy and renewable energy, infrastructure and food processing. In this context the MOU signed between Cassa Depositi e Prestiti and the NIIF will also provide a tool to support this interaction through innovative financial schemes.

5. What role can India play in Mediterranean region and will Italy be India's principal partner in that process

EAM Jaishankar participated last year in Rome MED, Italy's flagship conference committed to addressing the main challenges of the Mediterranean. His intervention was insightful and inspirational and proved that there truly is a seamless link between the Indian Ocean and the Mediterranean Basin. We are looking forward to India's contribution also to this year's edition. As I said before, connectivity will be a key factor in addressing the challenges that lie ahead in a post-Covid scenario.

<https://economictimes.indiatimes.com/news/defence/italian-defence-aerospace-firms-keen-to-explore-joint-production-or-technology-transfer-with-india-envoy/articleshow/79133926.cms>



Wed, 11 Nov 2020

Russia's top defence export body offers technology to India for production

By Sidhant Sibal

Story Highlights

Russia's top defence export body Rosoboronexport has expressed its readiness to give India technology for production of defence equipment

Russia's top defence export body Rosoboronexport has expressed its readiness to give India technology for production of defence equipment.

Earlier this month the body marked its 20th anniversary and in response to WION question it said, "historically, from the very beginning.....not only supplied military equipment but also provided assistance in organising its production, creating repair and maintenance facilities".

The company has worked together with Indian authorities for licensed production of multirole Su-30MKI fighter jets in India, the modernisation and transfer of the Vikramaditya aircraft carrier to the Indian Navy. India and Russia share a close defence partnership, something that has been the pillar of the much-celebrated relationship.

Calling the bilateral projects "fully consistent" with the Make in India program, Rosoboronexport pointed out that it has been actively working with major Indian industrial companies – HAL, OFB, Bharat Forge, Bharat Dynamics, etc – and has "always appreciated the highest level of their expertise."

The result of the Su-30MKI program was the induction into the Indian Air Force of a new aircraft, which has become the world's first super-maneuverable combat aircraft in serial production. It is also the first exported fighter jet equipped with the phased-array radar.

Joint production of Kalashnikov AK203 assault rifles by the specially established Indo Russia Rifles Private Limited (IRRPL) rifle manufacturing facility in Korwa, Amethi is the next key focus of both sides. While the project has its usual benefits of 100% localisation program, the project is still to be launched due to the absence of the production contract.



But the good news is, both sides have agreed on the technical configuration of the rifle. The AK203 project could become a major boost for the Amethi region, as well as potentially for India's export ambitions. The joint program also could see the possibility of rifles being exported to other countries.

<https://www.wionews.com/india-news/russias-top-defence-export-body-offers-technology-to-india-for-production-342250>



Wed, 11 Nov 2020

Sneak Peek: Did China accidentally reveal its new anti radiation missile on board J-11BS Flanker?

By Smriti Chaudhary

As China faces military challenges from the US in the sea and India at the land border, new images of a missile on the People's Liberation Army Air Force (PLAAF) J-11BS Flanker have surfaced on social media. While it is unclear which missile it is, experts have been deliberating it as a new anti-radiation missile.

Anti Radiation Missiles (ARM) strike any enemy radar emission source. It designates targets that emit radio-frequency including surface-to-air missile systems.

A Twitter user [@Rupprecht_A](#), whose Twitter bio reads that he is a China military aviation researcher, author, and China news reporter, was one of the first people to post these images.

Along with the pictures, he wrote that it is the new Chinese ARM. He revealed that the images are from the latest 2020 pilot recruiting video posted on a Facebook group. The images also show, for the first time, the PLAAF J-11BS, a twin-engine jet fighter taking off.

Thomas Newdick of *The Drive* stated that it's not possible to determine what unit the jet is assigned to and whether it is from an operational unit, or a test and evaluation outfit as the tail fins of the J-11BS were obscured.

While the quality of the images isn't very good, he observed that the "cruciform fins on its mid-body section and at the rear, very similar to the U.S. military's AGM-88 High-Speed Anti-Radiation Missile (HARM)."

Rejecting the possibility of the missile being the CM-102, a medium, supersonic AMR for manned and unmanned aircraft, Newdick said that CM-102's fins are cropped rather than pointed, and the mid-body fins are long and fairly slender.

"Apart from this, the CM-102 was also developed by China for export — primary for the JF-17 Thunder multirole fighter — and is not known to be in PLAAF service."

India has also successfully test-fired its first indigenous anti-radiation missile, the new-generation Rudram-1. Developed by the Defence Research and Development Organisation, the New Generation Anti-Radiation Missile (NGARM) has a launch speed of up to 2 Mach, twice the speed of sound, according to sources. The missile can be integrated with the Indian Air Force's Su-30MKI Flanker.

Experts have also suspected the new missile as a derivative of the PL-15 air to air missile.

"As a beyond-visual-range weapon, the PL-15 would make a potentially suitable candidate for an ARM derivative, potentially swapping out its air-to-air radar with a passive homing seeker to engage air defense targets and, since the PL-15 is scaled for internal carriage in the stealthy J-20 fighter, an ARM version could equip this jet, too," said Newdick.

The introduction of the new missile in the PLAAF is made at a time when China is surrounded by the US and India, both of whom are armed with surface to air missile systems.

India and Russia signed a \$ 5.43 billion contract for the S-400 Triumph ‘SA-21 Growler’ for the Indian Air Force and the delivery is expected to start in 2021.

The US has also agreed to sell Patriot Advanced Capability-3 (PAC-3) missiles to Taiwan for an estimated cost of \$620 million. Beijing has threatened to unify Taiwan, that it considers a renegade province, with force if necessary. On the other hand, Washington has promised Tapei to stand by its democratic rule of independence on the islands.

<https://eurasianimes.com/sneak-peek-did-china-accidentally-reveal-its-new-anti-radiation-missile-on-board-j-11bs-flanker/>

**INDIA
TODAY**

Wed, 11 Nov 2020

Indian Army gifts 20 fully trained military horses, 10 mine detection dogs to Bangladesh Army

*The Indian Army has also trained Bangladesh Army personnel
for training and handling these specialist dogs and horses*

By Manjeet Singh Negi

New Delhi: Towards further strengthening the bilateral relations between the two countries in general and between the two Armies in particular, the Indian Army gifted 20 fully trained military horses and 10 mine detection dogs to Bangladesh Army.

The equines and canines were trained by the Remount and Veterinary Corps of the Indian Army. The Indian Army has also trained Bangladesh Army personnel for training and handling these specialist dogs and horses.

The Indian Army delegation was led by Major General Narinder Singh Khroud, Chief of Staff of Brahmastra Corps whereas the Bangladesh Army Delegation was led by Major General Mohammad Humayun Kabir, who is commanding the Jessore based Division. The presentation ceremony was held at Petrapole-Benapole Integrated Check Post (ICP) on the India-Bangladesh Border.



The presentation ceremony was held at Petrapole-Benapole Integrated Check Post (ICP) on the India-Bangladesh Border.

Brigadier JS Cheema from the Indian High Commission in Dhaka was also present at the event.

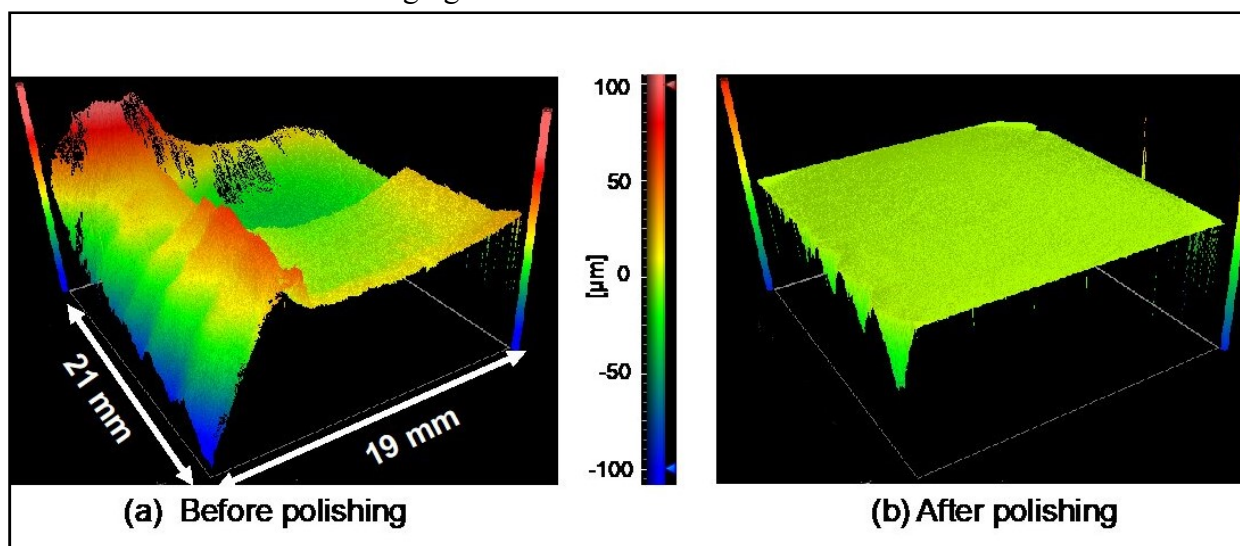
“The performance of military dogs in the Indian Army has been commendable. We are always ready to extend our assistance to a friendly country like Bangladesh in issues concerning security. When it comes to security, the dogs have proven their mettle. The dogs which have been handed over, are extremely effective in mine detection and contraband items,” a senior Army official said.

India’s partnership with the Peoples Republic of Bangladesh stands out as a role model in the region for good neighbourly relations. With this gesture, the bond which two countries share is expected to grow even stronger.

<https://www.indiatoday.in/india/story/indian-army-gifts-20-fully-trained-military-horses-10-mine-detection-dogs-to-bangladesh-army-1739759-2020-11-10>

Getting single-crystal diamond ready for electronics

Silicon has been the workhorse of electronics for decades because it is a common element, it's easy to process and has useful electronic properties. A limitation of silicon is that high temperatures damage it, which limits the operating speed of silicon-based electronics. Single-crystal diamond is a possible alternative to silicon. Researchers recently fabricated a single-crystal diamond wafer, but common methods of polishing the surface—a requirement for use in electronics—are slow and damaging to the material.



Shape of mosaic single crystal diamond substrate before and after plasma-assisted polishing. Credit: Osaka University

In a study recently published in *Scientific Reports*, researchers from Osaka University and collaborating partners polished a single-crystal diamond wafer to be nearly atomically smooth. This procedure will be useful for helping diamond replace at least some of the silicon components of electronic devices.

Diamond is the hardest known substance and essentially does not react with chemicals. Polishing it with a similarly hard tool damages the surface and conventional polishing chemistry is slow. In this study, the researchers in essence first modified the quartz glass surface and then polished diamond with modified quartz glass tools.

"Plasma-assisted polishing is an ideal technique for single-crystal diamond," explains lead author Nian Liu. "The plasma activates the carbon atoms on the diamond surface without destroying the crystal structure, which lets a quartz glass plate gently smooth away surface irregularities."

The single-crystal diamond, before polishing, had many step-like features and was wavy overall, with an average root mean square roughness of 0.66 micrometers. After polishing, the topographical defects were gone, and the surface roughness was far less: 0.4 nanometers.

"Polishing decreased the surface roughness to near-atomic smoothness," says senior author Kazuya Yamamura. "There were no scratches on the surface, as seen in scribe mechanical smoothing approaches."

Furthermore, the researchers confirmed that the polished surface was unaltered chemically. For example, they detected no graphite—therefore, no damaged carbon. The only detected impurity was a very small amount of nitrogen from the original wafer preparation.

"Using Raman spectroscopy, the full width at half maximum of the diamond lines in the wafer were the same, and the peak positions were almost identical," says Liu. "Other polishing techniques show clear deviations from pure diamond."

With this research development, high-performance power devices and heat sinks based on single-crystal diamond are now attainable. Such technologies will dramatically lower the power use and carbon input, and improve the performance, of future electronic devices.

The article, "Damage-free highly efficient plasma-assisted polishing of a 20-mm square large mosaic single-crystal diamond substrate," was published in *Scientific Reports*.

More information: "Damage-free highly efficient plasma-assisted polishing of a 20-mm square large mosaic single-crystal diamond substrate," *Scientific Reports* (2020). DOI: [10.1038/s41598-020-76430-6](https://doi.org/10.1038/s41598-020-76430-6)

Journal information: [Scientific Reports](https://www.nature.com/scientificreports/)

<https://phys.org/news/2020-11-single-crystal-diamond-ready-electronics.html>



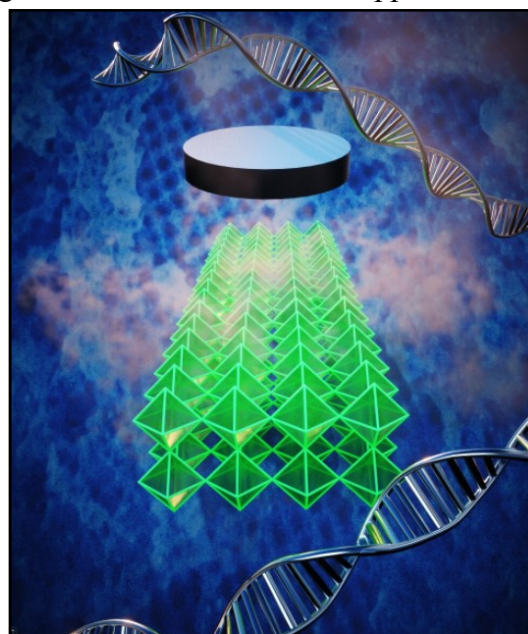
Wed, 11 Nov 2020

Making 3-D nanosuperconductors with DNA

Three-dimensional (3-D) nanostructured materials—those with complex shapes at a size scale of billionths of a meter—that can conduct electricity without resistance could be used in a range of quantum devices. For example, such 3-D superconducting nanostructures could find application in signal amplifiers to enhance the speed and accuracy of quantum computers and ultrasensitive magnetic field sensors for medical imaging and subsurface geology mapping. However, traditional fabrication tools such as lithography have been limited to 1-D and 2-D nanostructures like superconducting wires and thin films.

Now, scientists from the U.S. Department of Energy's (DOE) Brookhaven National Laboratory, Columbia University, and Bar-Ilan University in Israel have developed a platform for making 3-D superconducting nano-architectures with a prescribed organization. As reported in the Nov. 10 issue of *Nature Communications*, this platform is based on the self-assembly of DNA into desired 3-D shapes at the nanoscale. In DNA self-assembly, a single long strand of DNA is folded by shorter complementary "staple" strands at specific locations—similar to origami, the Japanese art of paper folding.

"Because of its structural programmability, DNA can provide an assembly platform for building designed nanostructures," said co-corresponding author Oleg Gang, leader of the Soft and Bio Nanomaterials Group at Brookhaven Lab's Center for Functional Nanomaterials (CFN) and a professor of chemical engineering and of applied physics and materials science at Columbia Engineering. "However, the fragility of DNA makes it seem unsuitable for functional device fabrication and nanomanufacturing that requires inorganic



An illustration showing how highly nanostructured 3-D superconducting materials can be created based on DNA self-assembly. Credit: Brookhaven National Laboratory

materials. In this study, we showed how DNA can serve as a scaffold for building 3-D nanoscale architectures that can be fully "converted" into inorganic materials like superconductors."

To make the scaffold, the Brookhaven and Columbia Engineering scientists first designed octahedral-shaped DNA origami "frames." Aaron Michelson, Gang's graduate student, applied a DNA-programmable strategy so that these frames would assemble into desired lattices. Then, he used a chemistry technique to coat the DNA lattices with silicon dioxide (silica), solidifying the originally soft constructions, which required a liquid environment to preserve their structure. The team tailored the fabrication process so the structures were true to their design, as confirmed by imaging at the CFN Electron Microscopy Facility and small-angle X-ray scattering at the Complex Materials Scattering beamline of Brookhaven's National Synchrotron Light Source II (NSLS-II). These experiments demonstrated that the structural integrity was preserved after they coated the DNA lattices.

"In its original form, DNA is completely unusable for processing with conventional nanotechnology methods," said Gang. "But once we coat the DNA with silica, we have a mechanically robust 3-D architecture that we can deposit inorganic materials on using these methods. This is analogous to traditional nanomanufacturing, in which valuable materials are deposited onto flat substrates, typically silicon, to add functionality."

The team shipped the silica-coated DNA lattices from the CFN to Bar-Ilan's Institute of Superconductivity, which is headed by Yosi Yeshurun. Gang and Yeshurun became acquainted a couple years ago, when Gang delivered a seminar on his DNA assembly research. Yeshurun—who over the past decade has been studying the properties of superconductivity at the nanoscale—thought that Gang's DNA-based approach could provide a solution to a problem he was trying to solve: How can we fabricate superconducting nanoscale structures in three dimensions?

"Previously, making 3-D nanosuperconductors involved a very elaborate and difficult process using conventional fabrication techniques," said Yeshurun, co-corresponding author. "Here, we found a relatively simple way using Oleg's DNA structures."

At the Institute of Superconductivity, Yeshurun's graduate student Lior Shani evaporated a low-temperature superconductor (niobium) onto a silicon chip containing a small sample of the lattices. The evaporation rate and silicon substrate temperature had to be carefully controlled so that niobium coated the sample but did not penetrate all the way through. If that happened, a short could occur between the electrodes used for the electronic transport measurements.

"We cut a special channel in the substrate to ensure that the current would only go through the sample itself," explained Yeshurun.

The measurements revealed a 3-D array of Josephson junctions, or thin nonsuperconducting barriers through which superconducting current tunnels. Arrays of Josephson junctions are key to leveraging quantum phenomena in practical technologies, such as superconducting quantum interference devices for magnetic field sensing. In 3-D, more junctions can be packed into a small volume, increasing device power.

"DNA origami has been producing beautiful and ornate 3-D nanoscale structures for almost 15 years, but DNA itself is not necessarily a useful functional material," said Evan Runnerstrom, program manager for materials design at the U.S. Army Combat Capabilities Development Command Army Research Laboratory of the U.S. Army Research Office, which funded the work in part. "What Prof. Gang has shown here is that you can leverage DNA origami as a template to create useful 3-D nanostructures of functional materials, like superconducting niobium. This ability to arbitrarily design and fabricate complex 3-D-structured functional materials from the bottom-up will accelerate the Army's modernization efforts in areas like sensing, optics, and quantum computing."

"We demonstrated a pathway for how complex DNA organizations can be used to create highly nanostructured 3-D superconducting materials," said Gang. "This material conversion pathway gives us an ability to make a variety of systems with interesting properties—not only superconductivity but also other electronic, mechanical, optical, and catalytic properties. We can

envision it as a "molecular lithography," where the power of DNA programmability is transferred to 3-D inorganic nanofabrication."

More information: *Nature Communications* (2020). [DOI: 10.1038/s41467-020-19439-9](https://doi.org/10.1038/s41467-020-19439-9)

Journal information: [Nature Communications](https://www.nature.com)

<https://phys.org/news/2020-11-d-nanosuperconductors-dna.html>



Wed, 11 Nov 2020

Researchers decode thermal conductivity with light

By Chris Worthy

Groundbreaking science is often the result of true collaboration, with researchers in a variety of fields, viewpoints and experiences coming together in a unique way. One such effort by Clemson University researchers has led to a discovery that could change the way the science of thermoelectrics moves forward.

Graduate research assistant Prakash Parajuli; research assistant professor Sriparna Bhattacharya; and Clemson Nanomaterials Institute (CNI) Founding Director Apparao Rao (all members of CNI in the College of Science's Department of Physics and Astronomy) worked with an international team of scientists to examine a highly efficient thermoelectric material in a new way—by using light.

Their research has been published in the journal *Advanced Science* and is titled "High zT and its origin in Sb-doped GeTe single crystals."

"Thermoelectric materials convert heat energy into useful electric energy; therefore, there is a lot of interest in materials that can convert it most efficiently," Parajuli said.

Bhattacharya explained that the key to measuring progress in the field is the figure of merit, noted as zT, which is highly dependent on the property of thermoelectric materials. "Many thermoelectric materials exhibit a zT of 1-1.5, which also depends on the temperature of the thermoelectric material. Only recently have materials with a zT of 2 or higher have been reported."

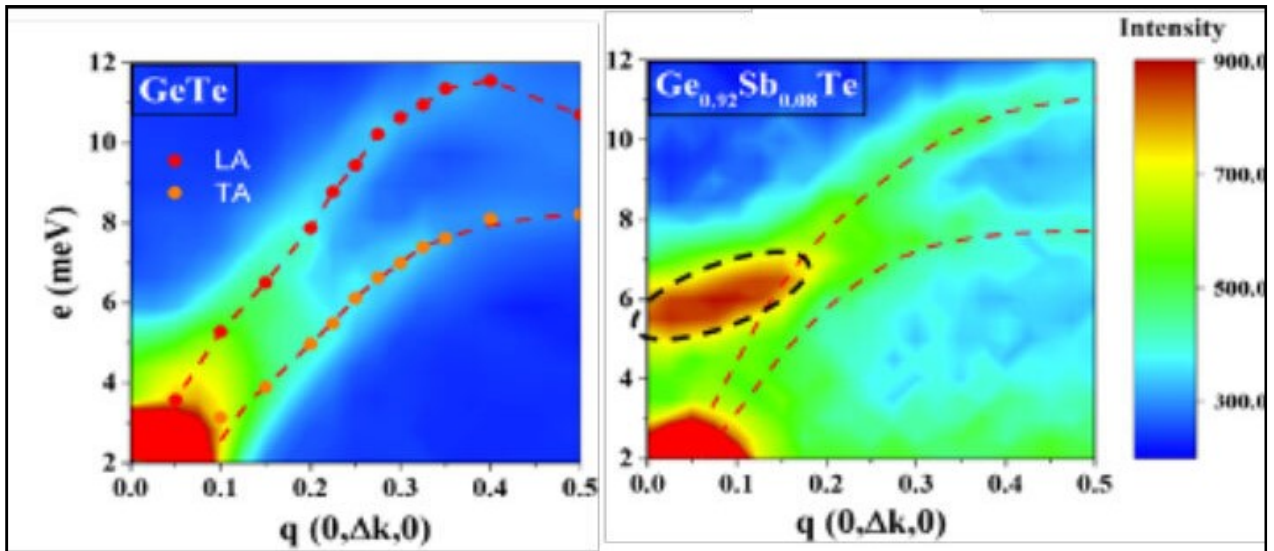
"This begs the question, how many more such materials can we find, and what is the fundamental science that is new here through which a zT greater than 2 can be achieved?" Rao added. "Basic research is the seed from which applied research grows, and to stay at the forefront in thermoelectrics we teamed up with professor Yang Yuan Chen's team at the Academia Sinica, Taiwan."

Chen and Rao's teams focused on Germanium Telluride (GeTe), a single crystal material.

"GeTe is of interest, but plain GeTe without any doping does not show exciting properties," Bhattacharya said. "But once we add a little bit of antimony to it, it does show good electronic properties, as well as very low thermal conductivity."



Collaborative research by (from left) Sriparna Bhattacharya, Prakash Parajuli and Apparao Rao has been published in the journal *Advanced Science*. Credit: College of Science



When the antimony dopant concentration reached 8 atomic percent, it resulted in the creation of a new set of phonons, highlighted by the dashed ellipse in the right panel. This new set of phonons serves as additional channels for phonon-phonon interactions, which leads to an effective reduction in heat flow. Credit: College of Science

While others have reported GeTe-based materials with high zT , these were polycrystalline materials. Polycrystals have boundaries among the many small crystals of which they are formed. While such boundaries favorably impede heat transfer, they mask the origin of fundamental processes that lead to high zT .

"Here, we had pure and doped GeTe single crystals whose thermoelectric properties have not been reported," Bhattacharya said. "Therefore, we were able to evaluate the intrinsic properties of these materials that would otherwise be difficult to decipher in the presence of competing processes. This may be the first GeTe crystal with antimony doping that showed these unique properties—mainly the ultra-low thermal conductivity."

This low thermal conductivity came as a surprise, since the material's simple crystalline structure should allow for heat to flow easily throughout the crystal.

"Electrons carry the heat and electricity, so if you block the electrons, you have no electricity," Parajuli said. "Hence, the key is to block the flow of heat by the quantized lattice vibrations known as phonons, while allowing electrons to flow."

Doping GeTe with the right amount of antimony can maximize electron flow and minimize heat flow. This study found that the presence of 8 antimony atoms for every 100 GeTe gives rise to a new set of phonons, which effectively reduce heat flow that was confirmed both experimentally and theoretically.

The team, along with collaborators who grew the crystals, performed electronic and thermal transport measurements in addition to density functional theory calculations to find this mechanism in two ways: first, through modeling, using the thermal conductivity data; second, through Raman spectroscopy, which probes the phonons within a material.

"This is a totally new angle for thermoelectric research," Rao said. "We are sort of pioneers in that way—decoding thermal conductivity in thermoelectrics with light. What we found using light agreed well with what was found through thermal transport measurements. Future research in thermoelectrics should use light—it's a very powerful nondestructive method to elucidate heat transport in thermoelectrics. You shine light on the sample, and collect information. You aren't destroying the sample."

Rao said that the collaborators' wide range of expertise was key to their success. The group included Fengjiao Liu, a former Ph.D. student at CNI; Rahul Rao, Research Physical Scientist at the Air Force Research Laboratory, Wright-Patterson Air Force Base; and Oliver Rancu, a high school student at the South Carolina Governor's School for Science and Mathematics who worked with the team through Clemson's SPRI (Summer Program for Research Interns) program. Because

of the pandemic, the team worked with Rancu via Zoom, guiding him with some of Parajuli's calculations using an alternate Matlab code.

"I am so very grateful for the opportunity to work with the CNI team members this summer," said Rancu, who hails from Anderson, South Carolina. "I have learned so many things about both physics and the research experience in general. It truly was priceless, and this research publication is just another addition to an already fantastic experience."

"I was very impressed by Oliver," Parajuli added. "He caught on quickly with the necessary framework for the theory."

More information: Ranganayakulu K. Vankayala et al, High zT and Its Origin in Sb-doped GeTe Single Crystals, *Advanced Science* (2020). DOI: [10.1002/advs.202002494](https://doi.org/10.1002/advs.202002494)
<https://phys.org/news/2020-11-decode-thermal.html>

COVID-19 Research News

live**mint**

Wed, 11 Nov 2020

Covid-19 Vaccines: What's coming and when?

- *As countries and companies race to produce a safe and effective coronavirus vaccine, here's a guide to the front-runners*

Some 200 Covid-19 vaccines are in development around the world, according to the World Health Organization, each one promising to protect people from the deadly coronavirus and allow them to go back to work and school.

Now, nearly a dozen are starting or nearing the final stage of testing. Depending on the results, some companies say their vaccines could be greenlighted for use as soon as this year.

The Front-Runners

Vaccine candidates in the final round of testing include one developed by the University of Oxford and AstraZeneca PLC, as well as one by Moderna Inc. An experimental shot by Pfizer Inc. and partner BioNTech SE has gotten better-than-expected trial results and is on track for potential regulatory clearance by the end of 2020.

Regulations for vaccine development and rollout vary world-wide. Chinese institutions have four vaccine candidates in the final stages of testing. Russia in August became the first country in the world to approve a state-developed vaccine—which it did before any advanced clinical testing—and has since approved a second one with plans for a third under way. Russia, China and the United Arab Emirates are allowing some of their citizens to get vaccinated before clinical trials wrap up.

Many vaccines that show promise in early testing fail during the final round. Trials involving two of the top-runners, developed by AstraZeneca and Johnson & Johnson, have been paused or halted because of illness in two study subjects—developments that aren't unusual in large clinical trials. While final-stage testing may stretch for months or even years to continue to track safety and the durability of protection, positive interim results from Phase 3 may be enough for a vaccine to start getting regulatory approval for mass production and distribution in the meantime. Several of the leading vaccine candidates expect interim results this fall.

The Oxford/AstraZeneca vaccine is designed to provide protection by delivering into a person's cells the genetic code for the spikes protruding from the new coronavirus. Then the cells can produce the spike proteins, generating an immune response that would be able to fight off the coronavirus.

Delivering those genetic instructions is a weakened, harmless version of a virus that causes the common cold in chimpanzees. In early testing, the vaccine successfully produced immune responses in humans with only minor side effects.

In early September, AstraZeneca suspended trials globally for its vaccine candidate after a woman in the U.K. experienced illness. The company resumed its U.K. study after investigating the incident, but a U.S. study aiming to enroll 30,000 subjects and other late-stage trials under way in Brazil and South Africa are still on hold.

Production capacity estimate: AstraZeneca aims to make two billion doses available world-wide, and has said that one billion may be available this year.

The Moderna vaccine also uses a gene-based technology to provoke an immune response, though the code it delivers takes the form of messenger RNA. Those molecules, commonly referred to as mRNA, are the body's molecular couriers ferrying DNA instructions for making proteins. The vaccine delivers to cells mRNA for making the coronavirus's spike protein.

Moderna and the U.S. National Institute of Allergy and Infectious Diseases are testing a two-dose shot. It was the first candidate to enter human testing in the U.S. The vaccine produced an immune response in early-stage testing and was generally well-tolerated, with minor side effects observed in test subjects.

Final-stage testing is under way in the U.S. with a 30,000-person trial that could yield interim results in the fall. An mRNA vaccine has never been approved for any disease.

Production capacity estimate: 500 million to one billion doses a year starting in 2021.

The vaccine developed by Pfizer and German partner BioNTech SE also uses mRNA. Phase 3 testing began in the U.S. in July, enrolling about 30,000 people, and will expand overseas to include about 120 sites. The vaccine reached a development milestone in early November, proving to be more effective than expected at protecting people from Covid-19, putting it on track for regulatory clearance by the end of the year.

The timeline suggests the vaccine could go into distribution in November or December, after U.S. health regulators conduct a review, though it will take months for the companies to make enough doses for the general population.

The U.S. government has agreed to pay Pfizer and BioNTech nearly \$2 billion for 100 million doses.

Production capacity estimate: up to 100 million doses world-wide by the end of 2020, and about 1.3 billion by the end of 2021.

China's state-owned Sinopharm is developing two vaccines with the government agencies Wuhan Institute of Biological Products and Beijing Institute of Biological Products. Both are based on an older vaccine-making technique.

The group has entered agreements to conduct testing in several countries, including Pakistan and the United Arab Emirates. The Wuhan Institute has drawn concern over its safety record, including over some of its vaccines for children.

The government says it started what it calls "emergency use" of some of its Covid-19 vaccines on medical workers and border inspection officials in late July. In mid-September, the U.A.E. government said it authorized a Sinopharm shot to be used on its front-line medical workers, becoming the first country outside China to approve emergency use of a Chinese Covid-19 vaccine candidate. Chinese officials have said they aim to make a vaccine available to the public before the end of the year.

Production capacity estimate: about 220 million doses a year.

Sinovac, a private Chinese company, began its final-stage trial in July in São Paulo, Brazil, where it is testing its vaccine to take advantage of a higher infection rate. Sinovac has also struck a deal with Indonesian state-owned pharmaceutical holding company PT Bio Farma to make up to 250 million vaccine doses each year for the Indonesian public, according to China's state news agency.

Production capacity estimate: about 300 million doses a year at a Beijing plant.

CanSino's vaccine is aimed initially at the Chinese military. Chinese company CanSino developed the shot with the military based on a weakened virus behind the common cold. A Phase 1 study was conducted in March in Wuhan, the early epicenter of Covid-19. The shot got government clearance in June for military use for one year.

Production capacity estimate: 100 million to 200 million doses a year starting in 2021.

Johnson & Johnson is developing a vaccine that uses a weakened form of a common-cold virus, known as an adenovirus. A single dose of this vaccine provoked a strong immune response in early animal testing. The company in September started a 60,000-person global study, which could be the largest late-stage clinical trial of a Covid-19 vaccine. On Oct. 12, Johnson & Johnson said it paused all of its clinical trials because of unexplained illness in a study volunteer, while an independent data-safety monitoring board reviews what happened.

The study had been planned at nearly 215 locations in the U.S. and eight other countries where transmission rates are high, including Brazil, Chile and South Africa.

Production capacity estimate: one billion world-wide by the end of 2021, including 100 million doses for the U.S., with an option for an additional 200 million, and 30 million doses for the U.K., with an option for an additional purchase of up to 22 million.

The Russian state-owned Gamaleya Research Institute is developing a vaccine based on a combination of two adenoviruses, which it has already tested on volunteers. Russia effectively approved use of the vaccine in early August, though the shot hadn't gone through final-stage testing. The Russian government plans for mass vaccination to start in October, and will aim rollout at high-risk groups including health workers.

Production capacity estimate: 500 million doses a year, with mass production starting September 2020.

Novavax's vaccine consists of two shots given 21 days apart that deliver proteins resembling the spike jutting out from the new coronavirus. Researchers hope the proteins will trigger the production of antibodies and immune cells that can fight off the coronavirus.

The shots also contain a component, called an adjuvant, to boost the immune response. In early-stage testing, the vaccine was generally well-tolerated and produced promising numbers of antibodies. The company in late September started a 10,000-person Phase 3 study in the U.K. A separate U.S. Phase 3 study is expected to begin in October.

Production capacity estimate: 100 million doses for use in the U.S., with delivery beginning by the end of this year, and a global manufacturing capacity of over 2 billion doses annually when at full capacity in 2021.

Jonathan D. Rockoff, Chao Deng, Raffaele Huang, Yan Wu, Georgi Kantchev, Jared S. Hopkins and Dasl Yoon contributed to this article.

Corrections & Amplifications

China National Pharmaceutical Group Co., or Sinopharm, has two vaccines in Phase 3. An earlier version of this article incorrectly said a vaccine. (Corrected on Sept. 3)

(This story has been published from a wire agency feed without modifications to the text)

<https://www.livemint.com/news/world/covid-19-vaccines-what-s-coming-and-when-11604989172033.html>

