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Business Standard

Thu, 12 Nov 2020

Homegrown firepower: Deadly Pinaka rocket gives Army cross-border options

The Enhanced Pinaka has demonstrated twice that range and an ability to strike within 10 metres of where it is aimed

By Ajai Shukla

The Pune-based Armament Research and Development Establishment (ARDE) has long been one of the most productive laboratories of the Defence Research and Development Organisation (DRDO). It has now scored another success with a copybook test of the Enhanced Pinaka rocket.

The Pinaka multi-barrelled rocket launcher (MBRL) is an important indigenous project aimed at providing the army with firepower superiority that would reduce casualties to soldiers in war. Each Pinaka launcher has 12 tubes, each one firing a rocket that plasters the enemy with 100 kg of high explosive. A salvo from a Pinaka battery, which fields six launchers, brings down on the enemy more than seven tonnes of high explosive in just 44 seconds.

So far, the army has fielded the Pinaka Mark I, with a range of 37.5 km and limited accuracy of about 500 metres. The Enhanced Pinaka has demonstrated twice that range and an ability to strike within 10 metres of where it is aimed.

“[The] Enhanced Pinaka rocket, developed by the DRDO, has been successfully flight-tested from Integrated Test Range, Chandipur off the coast of Odisha [last Wednesday]. A total of six rockets were launched in quick succession and the tests met complete mission objectives,” stated a

Ministry of Defence (MoD) release last Wednesday.

Business Standard visited ARDE Pune, and its sister laboratory, High Energy Materials Research Laboratory (HEMRL), for a rare briefing on the Pinaka MBRL programme and its warhead. HEMRL has developed the Pinaka warhead.

The Pinaka Mark I entered development in 1988 and a prototype version was deployed in combat during the Kargil War of 1999. After it was proven in user trials in 2002, production orders were placed.

Currently, four Pinaka regiments are in service and another six are under procurement.

In 2016, the army realised that the “free-flight” Pinaka Mark I rockets would have only limited accuracy and asked the DRDO to try and provide a guidance kit to each individual rocket.

ARDE took up the “Enhanced Pinaka” project, setting goals that would make the Pinaka a world-class rocket.

In January 2017, ARDE demonstrated the first flight of the Enhanced Pinaka. The army had asked for a range of 60 km, but ARDE achieved 75 km in the very first flight.

Against a desired accuracy of 30 metres, the Pinaka proved it could strike within 10 metres of the target.

“This high accuracy means that just two Enhanced Pinaka rockets must be fired to assure a kill probability of more than 99 per cent,” says ARDE Director V Venkateshwar Rao.

The accuracy and range that the DRDO claims for the Guided Pinaka puts it on a par with the US Army's M270 Multiple Launch Rocket System (M270 MLRS), which boasts the same accuracy figures.

Key to the Enhanced Pinaka's success is a guidance system that combines an inertial navigation system (INS) with satellite navigation.

The rocket's guidance system has been integrated with the Indian Region Navigation Satellite System (IRNSS) – the Indian version of the Global Positioning System (GPS) that the US invented. A constellation of IRNSS satellites is already deployed.

“Most rockets and missiles, which are not tube-launched, have plenty of space on board. But, in the Pinaka, which is launched from a 214 mm-wide tube, space is critical. It is a technological challenge to house the on-board computer, telemetry, power supply and navigation system inside such a small rocket,” explains Rao.

The continuous in-flight guidance the Enhanced Pinaka receives corrects for inaccuracies imposed by meteorological conditions such as stiff winds. This eliminates the requirement of a meteorological radar.

So far, the Ordnance Factory Board (OFB) has been manufacturing the Pinaka Mark I rocket, but the army and the DRDO have decided to create a second source of supply in the private sector. The army has already floated a tender with the private industry for about 11,000 Pinaka Mark I rockets.

“[The Enhanced Pinaka] rockets tested have been manufactured by M/s Economic Explosives Limited, Nagpur, to whom the technology has been transferred,” stated the MoD.

The army's total requirement of Pinaka units is of the order of 22 regiments, all of which will be modified with electronic kits. That will allow them to fire both Pinaka Mark I and Guided Pinaka rockets.

The Enhanced Pinaka provides the army with a weapon for accurately striking deep-lying targets, such as terrorist camps across the Line of Control, eliminating the need to risk soldiers or aircraft in cross-border “surgical strikes”.

This weapon could also support wartime attacks under the army's “Cold Start” plan, which involves capturing enemy positions in lightning strikes before they can be reinforced. The volume and precision of firepower that a Pinaka regiment brings down would stun defenders and leave attacking forces with an easy task.

https://www.business-standard.com/article/economy-policy/homegrown-firepower-deadly-pinaka-rocket-gives-army-cross-border-options-120111102049_1.html



Thu, 12 Nov 2020

Army Chief Gen Narvane reviews military preparedness along China border in Uttarakhand

Army chief General Naravane on Wednesday reviewed military preparedness along the China border in Uttarakhand

By Manjeet Singh Negi

New Delhi: Army Chief General Manoj Mukund Naravane on Wednesday visited the Indian military formations along the China border in Uttarakhand to review the operational preparedness of troops there.

The army chief has visited the forward areas on several occasions since the standoff with Chinese troops broke on the Line of Actual Control (LAC) in early May.

Uttarakhand shares a long border with China. Hence, the Indian Army has done robust deployment there to prevent any misadventure by the Chinese army.

Ladakh standoff on verge of resolution?

The latest developments indicate that India and China may be on the verge of a breakthrough in resolving the over six-month-long tense border standoff in eastern Ladakh with both sides broadly agreeing on a three-step process on disengagement of troops and withdrawal of weaponry from all major friction points in a time-bound manner.

Government sources have told India Today TV that the ongoing India-China standoff may be resolved soon as the armies of the two countries have agreed for disengagement from both the southern and northern banks of the Pangong Lake and the process might be over in a few days.

“You may hear the good news around Diwali in few days,” sources told Aajtak and India Today on Wednesday.

What is the 3-step disengagement plan?

As per the three-step disengagement plan, to be carried out in a week in the Pangong lake area, tanks and armoured personnel carriers are to be moved back from their frontline deployment to a significant distance from the Line of Actual Control (LAC) by both sides within one day, the sources said.

In the second step, near Pangong lake area, both sides are supposed to withdraw around 30 per cent of troops every day for three days. The Indian side will be coming close to its administrative Dhan Singh Thapa post while the Chinese consented to go back to the east of Finger 8.



File photo of Army chief General MM Naravane reviewing the operational preparedness of troops at Ladakh border (PTI image)

In the third step, India and China are supposed to withdraw from their respective positions from the frontline along the southern bank of the Pangong Lake area which includes the heights and territories around Chushul and Rezang La area.

<https://www.indiatoday.in/india/story/army-chief-gen-narvane-reviews-military-preparedness-along-china-border-in-uttarakhand-1740116-2020-11-11>



Thu, 12 Nov 2020

थलसेना अध्यक्ष जनरल मनोज मुकुंद नरवाने ने चीन सीमा पर चौकियों का किया हवाई निरीक्षण

थलसेना अध्यक्ष जनरल मनोज मुकुंद नरवाने ने माणा पास स्थित भारत चीन सीमा का हवाई निरीक्षण किया। बुधवार सुबह थल सेना अध्यक्ष नरवाने के हेलीकॉप्टर को बदरीनाथ के माणा में सेना के हेलीपैड पर उतरना था। लेकिन उनके हेलीकॉप्टर ने यहां लैंडिंग नहीं की।

By Sunil Negi

गोपेश्वर (चमोली): सेना प्रमुख जनरल मनोज मुकुंद नरवाने ने बुधवार को उत्तराखंड के चमोली जिले में माणा पास से लगी सीमांत चौकियों का हवाई निरीक्षण किया। इसके बाद जोशीमठ में सैन्य अधिकारियों न जवानों से मुलाकात की। सीमा की स्थिति की जानकारी लेने के साथ ही उन्होंने परिचालन संबंधी (ऑपरेशनल) तैयारियों की समीक्षा की। वहीं, जवानों का हौसला भी बढ़ाया।



बुधवार सुबह करीब 11:50 बजे जनरल नरवाने के हेलीकॉप्टर को माणा में सेना के हेलीपैड पर उतरना था। इसके लिए हेलीपैड पर पूरी तैयारियां की गई थी, लेकिन हेलीकॉप्टर यहां लैंड करने के बजाय माणा पास से लगी

सीमा चौकियों के निरीक्षण को रवाना हो गया। आधिकारिक सूत्रों के अनुसार, सेनाध्यक्ष ने चीन सीमा से लगी भारत की अग्रिम चौकियों नीति पास और रिमखिम का भी हवाई निरीक्षण किया।

इसके बाद वह ब्रिगेड हेडक्वार्टर जोशीमठ पहुंचे। जानकारी के अनुसार जनरल नरवाने दो दिवसीय दौरे पर उत्तराखंड पहुंचे हैं। वह गुरुवार को भी सीमा का निरीक्षण कर सकते हैं। उत्तराखंड का यह सीमांत क्षेत्र किस कदर संवेदनशील है इसका अंदाजा इसी बात से लगाया जा सकता है कि वर्ष 2014 से 2018 तक चमोली जिले की मलारी घाटी में स्थित बाड़ाहोती में 10 बार चीनी सैनिक घुसपैठ कर चुके हैं। हालांकि हर बार चीनियों के मंसूबों को अग्रिम मोर्चे पर तैनात भारत-तिब्बत सीमा पुलिस और भारतीय सेना के जवानों ने नाकाम कर दिया।

बता दें कि पूर्वी लद्दाख में वास्तविक नियंत्रण रेखा पर भारत-चीन के बीच बढ़ते तनाव के बाद उत्तराखंड के सीमांत इलाकों में सेना पूरी तरह मुस्तैद है। भारत-चीन के बीच उत्तराखंड में 345 किमी लंबी सीमा है। पिथौरागढ़, चमोली और उत्तरकाशी के सीमावर्ती क्षेत्र चीन सीमा से सटे हैं। चीन संग जारी तनाव के बीच उत्तराखंड में अंतरराष्ट्रीय सीमा पर चौकसी कड़ी कर दी गई है।

सेना और आइटीबीपी के साथ-साथ वायुसेना भी अलर्ट पर है। सुरक्षा की तैयारियों के बीच वायु सेना उत्तराखंड के पहाड़ी क्षेत्रों में अपना एडवांस लैंडिंग ग्राउंड भी मजबूत करने जा रही है। वायु सेना ने उत्तराखंड सरकार से एयरस्टिप और रडार लगाने के लिए जमीन मांगी है।

<https://www.jagran.com/uttarakhand/chamoli-army-chief-general-manoj-mukund-naravane-reached-chamoli-21052174.html>



DEFENCE AVIATION POST

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Thu, 12 Nov 2020

India has opportunity to export drones, IT services and warships” repair services in IOR: Navy Chief

India has the opportunity to export drones, IT-enabled services and warships” maintenance, repair and overhaul (MRO) services in the Indian Ocean Region (IOR), said Chief of Naval Staff Admiral Karambir Singh on Tuesday.

He also suggested that a partnership model can be explored between the Indian industry and other countries, primarily in the IOR, for construction of patrol vessels.

Warships need periodic maintenance or repairs and it takes time and money if they have to return to their home port for it, Singh said in his speech at a conclave organised by Bharatshakti.in, a portal on defence issues.



The IOR is teeming with maritime activity as around 70 warships from 40 countries are operating at any time in it and some of the warships are far away from their home countries, he said.

In addition to its location, India has a large number of shipyards in the IOR and therefore, it is only a question of how to fully harness this head room and diversify into developing warship repair capability, Singh added.

He said India could offer refits, dry docking, logistics support, assisted maintenance and repair of critical equipment to warships of other countries operating in the IOR.

India has a strong presence in IT space and it can look at opportunities to export IT and IT-enabled services in the IOR, the Navy chief said.

“Right from basic administration, to security overlays on e-Office, to more complex decision support systems, embedded software for machinery, servers, communication systems, combat management systems to integrated platform management systems, we are relying more and more on IT and Indian IT is greatly supporting us,” he said.

On opportunities to export drones, Singh said small-sized drones is an area where Indian industry has the capability and it can take an early mover advantage in concert with India’s neighbours.

“While large sized drones such as MQ9B Reaper have changed the face of warfare, there is increasing utility of small, micro and mini drones as well,” the Navy Chief noted.

<https://www.defenceaviationpost.com/2020/11/india-has-opportunity-to-export-drones-it-services-and-warships-repair-services-in-ior-navy-chief/>

OFB to soon offer its indigenous anti-material sniper rifle to Army for trials

Soumyadip Mullick

Camouflaged in a ghillie suit, a sniper patiently waits to fire a shot that can neutralise targets and their war assets beyond enemy lines with highest precision and maximum damage.

The Ordnance Factory Board (OFB) is soon to offer its indigenously developed large-calibre sniper anti-material rifle (AMR) to the Indian Army for trials after having incorporated modifications as per the latter's requirement. The large calibre AMR, named 'Vidwanshak' is a 100 per cent indigenous weapon by OFB, launched during the 'Atmanirbhar Week'.

Sources in the Kolkata based defence manufacturer- OFB, confirmed to The Statesman that some orders were received for the rifle from state police organisations and Central Armed Police Forces (CAPF). The BSF and the CRPF are the existing users of the weapon.

"Vidwanshak is a multi-calibre sniper rifle chambered for two types of calibres- 14.5mm and 20mm. It can be used in anti-material role for destroying enemy bunkers, lightly armoured vehicles, radar systems, communication equipment, parked aircraft, fuel storage facilities etc" explained the source who added, it is a "single shot, bolt-action rifle having a detachable three round magazine and a range of 1800m for 14.5mm calibre ammunition and 1300m for the 20mm calibre. The advantage is, the rifle can quickly be dismantled and carried in two portable man-packs, each weighing 12 to 15 kgs."



The Indian Army earlier imported such 14.5mm/20mm anti-material sniper rifles from the South African company, Denel Land Systems.

To boost the Atmanirbhar policy, OFB developed the AMR through its in-house R&D wing of Ordnance Factory (OF), Trichy without any MoU with foreign collaborators and support from external agencies, factory sources confirmed.

Due to this indigenisation, foreign exchange to the tune of USD 90 million will be saved, it said.

However, the Army reportedly had earlier desisted from procuring the Vidwanshak rifle due to its heavy-weight which affected portability. OFB sources highlighted "the weight of the weapon is comparatively lesser than the South African made AMR which were used by the Army. This weapon also has advanced optical telescoping sights. We have completed modifications on the rifle as per the Army requirement and will offer it for trials soon."

<https://www.thestatesman.com/cities/kolkata/ofb-soon-offer-indigenous-anti-material-sniper-rifle-army-trials-1502934744.html/amp>

Unified maritime command will have IAF's strike elements, Army's amphibious units

An ongoing study on Maritime Theatre Command is currently at an advanced stage. It is likely to come soon after the Air Defence Command is set up

By Amrita Nayak Dutta

New Delhi: The Maritime Theatre Command — comprising all the naval assets — will come up soon after the unified Air Defence Command is set up, ThePrint has learnt.

An ongoing study on the maritime command is currently at an advanced stage, top defence sources said.

The Air Defence Command, responsible for guarding the Indian airspace from hostile air elements, was initially reported to be set up by October. A new date, however, is yet to be formally announced. The study on the Maritime Theatre Command has been under way for the last several months.

A senior defence source told ThePrint that the command is more likely to be headquartered at Karwar in Karnataka. Hyderabad is also under consideration, though, it is learnt.

It will likely be headed by an Indian Navy officer of vice-admiral or admiral rank.

According to defence officials, the Maritime Theatre Command will comprise both the Eastern and Western Naval Commands, with the Andaman and Nicobar Command subsumed into the Eastern Naval Command.

The Andaman and Nicobar Command, set up in October 2001, and the Strategic Forces Command, set up in 2003, are the only two unified tri-services commands.

“It (maritime command) will also have shore-based maritime strike elements of the IAF and some amphibious elements of the Army,” a senior defence official said.

Amphibious elements of Army include infantry, mechanised as well as armoured regiments, which are presently capable of executing amphibious operations.

Maritime strike aircraft with the IAF includes certain squadrons of Sukhoi-30 and Jaguar fighters, and their primary role is to strike enemy naval facilities on shore, naval vessels and installations in harbour and carry out anti-shipping strikes against enemy naval assets when in vicinity of India's naval forces.

A senior Navy officer told ThePrint the maritime command will reduce the inter-service mobilisation time for operational events and increase cohesion in joint training.

“Tri-services coordination will increase within the components placed in the theatre commands.”

The officer added, “Subsuming the Andaman and Nicobar Command into the Eastern Naval Command will provide greater force levels in the Bay of Bengal, while also increasing resources available at the islands to address any threat from the east.”



Representational image of Indian Navy ships | Photo: Commons

At present, the Indian Navy is divided into two operational fleets, with the western fleet addressing the western theatre and eastern fleet addressing the threats in the east and a training command in the south.

The new theatre command aims to bring them all under one theatre command, which will address all threats emanating in the maritime domain.

‘Squadron of fighter-bombers, carrier task group’

Former Navy chief Admiral Arun Prakash (retd) told ThePrint that the Chiefs of Staff Committee currently has plans for a number of ‘out of area contingencies’, which require elements of all three services to form a task force for joint expeditionary operations in India’s maritime neighbourhood.

“In the past, we have undertaken such operations in Sri Lanka, Maldives and Mauritius. In future, we may require such task forces for defence of our own islands or rendering assistance under ‘Mission SAGAR’,” he said.

“Given our current organisation, the task force would need contributions from any of the 17 commands scattered all over India. Once we constitute one or more maritime commands, all these elements will be brought under a single theatre commander,” he added.

Talking about the possible composition of the command, he said there should be an Independent Infantry Brigade from the Army with elements of armour, artillery and supporting arms, which would be trained and dedicated to the amphibious role.

“From the IAF, (there should be) a squadron of fighter-bombers dedicated to maritime strike and some transport aircraft. From the Navy, a carrier task group, along with submarines and support vessels, (should be part of the command).”

In May, Chief of Defence Staff General Bipin Rawat had said the Maritime Theatre Command is the next thing being looked at after the Air Defence Command and could come up by early next year.

“Today, the ships are operational under different commanders, but it is being seen if the command and control of the ships can be exercised by one entity as the maritime commander,” he had said.

Multiple theatre commands in the offing

Apart from the Air Defence Command and the Maritime Theatre Command, multiple theatre commands would be set up, including at the northern and western borders, although the exact number would be based on emerging threat assessments.

There are also plans to set up joint commands for logistics and training of the military.

A theatre command will have specific units of personnel from the three services — Army, Navy and Air Force — under a common commander so they fight as a cohesive unit. Both the US and China follow a theatre command doctrine.

<https://theprint.in/defence/unified-maritime-command-will-have-iafs-strike-elements-armys-amphibious-units/541478/>



Thu, 12 Nov 2020

Indian Navy: Time to expand the geographical scope of mission based deployments

The Indian Navy has added a new acronym—TIDE—to its lexicon, which stands for Trust; Interoperability; Domain Awareness; and Enhanced Engagements. In his online address, titled “SAGAR – Charting India’s Maritime Security,” to the National Defence College, India’s Navy Chief, Adm Karambir Singh, emphasised that TIDE is closely linked with Indian Prime Minister Narendra Modi’s vision of Security and Growth for All in the Region (SAGAR), an initiative that was announced five years ago in Mauritius.

Adm Singh also alluded to the Indian Navy’s three ‘Lines of Effort’: (a) collaboration and cooperation; (b) enhancing positive influence in the region; and (c) enhancing reach and sustenance in the farthest corners of India’s areas of interest, which resonate with “like-minded maritime nations, and are focused towards pursuance of our overall national and regional maritime objectives.”



However, in the same breath, ostensibly referring to China, he was unequivocal that the ‘global commons’ could emerge as ‘contested seas’ threatening free flow of commerce and trade. Addressing this, he argued, necessitates a “pragmatic and outcome based strategy, rather than a purely conceptual.”

Although it is fashionable for militaries to coin acronyms for long or complex formulations for use in their day-to-day operational and administrative functioning, Adm Singh’s acronym, TIDE, embeds three important security discourses—cooperative, convergent, and competitive. These are also echoed in India’s politico-diplomatic thinking and strategic decision-making.

The ‘cooperative’ discourse is led by SAGAR, which motivates states to “conserve and sustainably use the maritime domain, and to make meaningful efforts to create a safe, secure and stable maritime domain.” Its primary focus is on the Indian Ocean, in which India is an important player and has been labelled as the ‘net security provider’.

Its contribution to regional grouping such as the Indian Ocean Rim Association (IORA), the Indian Ocean Commission (IOC), the Djibouti Code of Conduct, the Indian Ocean Naval Symposium (IONS) etc is worth mentioning.

<https://www.defenceaviationpost.com/2020/11/indian-navy-time-to-expand-the-geographical-scope-of-mission-based-deployments/>

Indian Army, China's PLA consider scaling up disengagement

The PLA's behaviour is unusual when judged on the benchmarks of China's own conduct in previous territorial disputes with India

By Kunal Singh

The ongoing face-offs between India and China have taken a dangerous turn. Reports are still sketchy but it seems like there were violent scuffles after People's Liberation Army (PLA) troops refused to follow a disengagement plan that had been agreed upon by the two sides. We know the casualty numbers on the Indian side but have only unconfirmed reports about the Chinese side. It is too early to conclude anything about the military situation on the line of actual control (LAC). What is clearer is that China is willing to escalate militarily for the small pieces of land it has occupied around Pangong Tso, Galwan Valley, and the Hot Springs.

The PLA's behaviour is unusual when judged on the benchmarks of China's own conduct in previous territorial disputes with India. So far, the Chinese tendency to initiate a military conflict has been correlated with the stakes involved in the territory for Beijing. Let us consider three regions whose status has or had been a bone of contention between the two countries: Tibet, Aksai Chin, and Sikkim.

These three case studies provide ample variation in the nature of dispute and the extent of military escalation by China. India was not a direct party to the dispute in Tibet. New Delhi's interest was in the kind of relationship it would have with Tibet, and hence the kind of autonomy Tibet would enjoy under Communist rule. The Chinese leadership, however, believed that India wished to create a buffer zone in Tibet. Aksai Chin, on the other hand, has been a direct dispute between India and China. Sikkim's status was a contestation between the Indian government and the Chogyal in Sikkim. China was the third party which would have liked Sikkim to continue as a buffer zone. So, the Chinese stakes were highest in Tibet and lowest in Sikkim, with Aksai Chin in between.

The case of Aksai Chin, however, was linked to the fate of Tibet. India's claim on Aksai Chin was annoying for China because the territory provided, in 1950s, the most viable link between China and Tibet. Other routes, from Qinghai province in the north and Sichuan basin in the east, were subjected to adverse weather patterns, difficult terrain and a Kham insurrection, which the Chinese believed was being supported by India along with the American Central Intelligence Agency. Moreover, Indian claims over Aksai Chin were inconsistent over time. Jawaharlal Nehru's position on Aksai Chin hardened when Sarvepalli Gopal, a historian with India's ministry of external affairs, studied the historical documents and convinced the former, in 1960, about Indian claims over the territory. Given that Dalai Lama had fled to India in 1959, the change in Indian position on Aksai Chin could have come across to the Chinese leadership as linked to New Delhi's "designs" over Tibet.

The most convincing explanation of China initiating a war against India in 1962 has to do with Tibet. India's inconsistency over Aksai Chin and Nehru's flawed Forward Policy—raising posts and conducting patrols in the disputed areas — definitely contributed to the war. But they were



Ladakh, Sep 16 (ANI): Indian Army troops during a mock drill practice, in Leh on Tuesday. (ANI Photo)(ANI)

mere confirmation to the Chinese leadership of their prior beliefs about India's designs on Tibet. India's annexation of Sikkim in 1975 did not elicit a military response from China. The Chinese stakes were the lowest in Sikkim, and that could explain why the PLA did not escalate the 1967 clashes in Sikkim. Aksai Chin was a theatre of conflict in 1962 but Indian moves in that region, when considered separately from their implications over the status of Tibet, would not have prompted a full-fledged war.

The current crisis involves new intrusion points which were not part of the Aksai Chin dispute. There is an argument that the Indian decision to amend Article 370 and create a new Union Territory of Ladakh in August 2019 could have led China to believe that India intends to change the status quo in Aksai Chin. This is a tenuous claim because the fact is that the Indian position and claims on Aksai Chin haven't changed. India's map before and after the amendment of Article 370 look exactly identical except for the addition of an extra line between Jammu and Kashmir and Ladakh, and this line is hundreds of kilometres away from the LAC around which the disputes lie. The amendment of Article 370 also does not, in any sense, affect India's ability to alter the status quo in Aksai Chin.

It seems far-fetched that the decision to issue a new map before and after the creation of Ladakh as a separate UT — which, to reiterate, is identical to the old map — indicates any Indian territorial “design” over Aksai Chin. The PLA's behaviour also does not show that Article 370 has much relevance to whatever it has been up to. For instance, even the recent intrusions involve one in Naku La in Sikkim which has nothing to do with Article 370. PLA has undertaken similar unilateral actions, albeit on a lower scale, in 2013 (Depsang) and 2014 (Chumar), much before Article 370 was amended. Beijing has inserted itself into the Kashmir dispute by signing off on the China-Pakistan Economic Corridor, also much before August 2019. The trend is clear: China is moving forward into territory where it has neither been a disputant nor does it have high stakes. But since the economic and military gap between the two Asian giants have widened, China is pressing forward to create new buffer zones. With every crisis, China aims to expand its claims and create new limits for the Indian patrols. With the widening capability gap, the old standards of behaviour — military action only when the stakes are high — are no longer applicable. With fewer material constraints, China is creating new areas of interest, new buffer zones, new standards of behaviour, and new realities on the ground.

(Kunal Singh is pursuing a PhD in political science from the Massachusetts Institute of Technology) The views expressed here are personal.

<https://www.hindustantimes.com/analysis/indian-army-china-s-pla-consider-scaling-up-disengagement/story-XPp669m4eGuVK1WkX2dYDJ.html>

सरहद पर चीन ने टेके घुटने, 3 बार में दोनों ओर से हट जाएंगे जवान

भारत और चीन (India-China Border tension) के बीच LAC पर तनाव कम हो गया है। सूत्रों के मुताबिक पूर्वी लद्दाख में दोनों सेनाओं के बीच जारी सीमा संघर्ष (India-China Standoff) का जल्द हल निकल सकता है

नई दिल्ली: भारत और चीन (India-China Border tension) के बीच LAC पर तनाव कम हो गया है। सूत्रों के मुताबिक पूर्वी लद्दाख में दोनों सेनाओं के बीच जारी सीमा संघर्ष (India-China Standoff) का जल्द हल निकल सकता है। दोनों देशों की सेनाओं में पूर्वी लद्दाख (Eastern Ladakh) सेक्टर के कुछ हिस्सों से हटने पर सहमति बनी है। समझौते के तहत चीनी सेना वापस उसी इलाके में जाने के लिए तैयार है, जहां पर अप्रैल में थी।

हमारी सहयोगी साइट Zee News की खबर के मुताबिक 6 नवंबर को चुशूल में हुई 8वीं वाहिनी कमांडर-स्तरीय वार्ता के दौरान दोनों देशों के बीच इस योजना पर चर्चा की गई। वार्ता में चीन के प्रस्ताव पर भारत विचार कर रहा है। सब ठीक रहा तो तीन चरणों में सेना की वापसी होगी। पहले टैंक और बख्तरबंद गाड़ियों की वापसी होगी। दूसरे चरण में फिंगर एरिया से 3 दिन में सैनिक हटेंगे और अंत में एलएसी (LAC) से सैनिक पीछे हट जाएंगे।

6 नवंबर को बैठक में विदेश मंत्रालय (MEA) के संयुक्त सचिव नवीन श्रीवास्तव और मिलिट्री ऑपरेशन के DG मौजूद थे। भारत इस मामले में पूरी सतर्कता के साथ आगे बढ़ रहा है क्योंकि जून 2020 में गलवान घाटी (Galvan Valley) संघर्ष के बाद चीन पर विश्वास करना आसान नहीं है। इस संघर्ष में भारतीय जवानों ने अपनी जान गंवाई थी। इस हरकत का भारत ने भी करारा जवाब दिया। चीन के कमांडिंग अधिकारी सहित कई चीनी सेना के ढेरों जवान भी मारे गए।

प्रधानमंत्री नरेंद्र मोदी (PM Narendra Modi) की विश्वसनीय टीम के लोगों-राष्ट्रीय सुरक्षा सलाहकार (NSA) अजीत डोभाल, चीफ ऑफ डिफेंस स्टाफ (CDS) जनरल बिपिन रावत, आर्मी चीफ जनरल मनोज मुकुंद नरवाने और एयरफोर्स चीफ आरकेएस भदौरिया ने मामले में कड़े कदम उठाए। LAC पर पैंगोंग झील के दक्षिणी और उत्तरी किनारे पर सैन्य ताकत बढ़ाई।

चीन ने भी बड़े पैमाने पर सैनिकों की तैनाती की। जवाब में भारत ने भी 60,000 सैनिकों की तैनाती की। Indian Air Force ने मोर्चा संभाला। लड़ाकू जेट तैनात किए ताकि इलाके में दुश्मन का कोई भी विमान घुसने न दिया जाए।

<https://www.zeebiz.com/hindi/india/india-china-standoff-chinese-soldiers-ready-to-vacate-ladakh-line-of-actual-control-38359>

Thu, 12 Nov 2020

IIT Kanpur signs e-MOU with Dynamatic Technologies Ltd to build unmanned aircraft for Indian Army

The institution will soon be building unmanned aircrafts (UAVs) and drones by using state-of-the-art technology

By Prerona

Adding another feather to its cap, IIT Kanpur is all set to advance the growth of the Indian Army with its technological expertise. The institution will soon be building unmanned aircrafts (UAVs) and drones by using state-of-the-art technology, which will not only strengthen the surveillance system but will also ease any kind of rescue mission. For this venture, on Monday evening, an e-MoU with Bangalore-based Dynamatic Technology Limited has been signed.

Director of IIT, Prof. Abhay Karandikar, Dean Research and Development Prof. AR Harish and Aerospace Engineering Prof. Dr. Udayant Malhoutra, MD & CEO of Dynamatic Technologies and Global COO Arvind Mishra, were present during the agreement. Prof Abhishek mentioned that IIT Kanpur has made many UAVs and drones.



This UAV can fly like a helicopter. The department is also working on a flying taxi, which is unmanned. Its pilot testing has been done at the institute itself and quadcopters (extremely small drones) have also been developed by IIT-K.

The features of these machines would include dodging enemies at the time of surveillance, extremely low noise, flying in the air for more than an hour, delivering relief material of 20 to 40 kg, taking accurate photos and videos of sensitive areas, amidst others. Additional highlights are the machines will be able to fly at altitudes up to 20 thousand feet and its fuel, petrol and battery, will remain powered.

<https://www.knocksense.com/kanpur/iit-kanpur-signs-e-mou-with-dynamatic-technologies-ltd-to-advance-the-growth-of-indian-army>



Evolving Indo-US co-operative engagement scheme: BECA, COMCASA, LEMOA

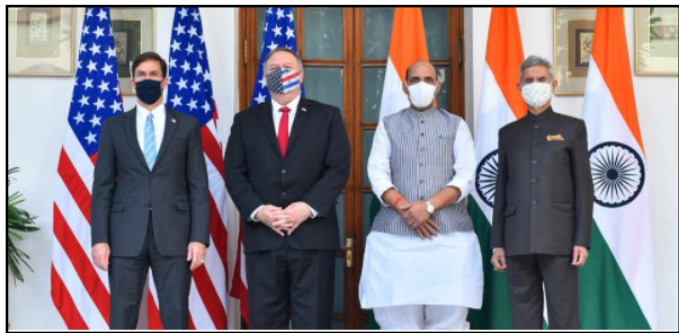
By Cdr Milind Kulshreshtha (Retd) (Editor's Note)

BECA, COMCASA and LEMOA, put together, have altered the parameters of inter-operability not just with the US forces but a host of others. Operational compatibility through data sharing and logistics required for responding armed forces irrespective of flags they fly, subject to such countries being signatories to these agreements, is enhanced disproportionately. The author debates the issues based on the dividends accruing from an operational viewpoint.

India has been working continuously on the modernization of its military equipment, and induction of various hi-tech US military hardware. The transactions have been feasible mostly due to the heightened inter-governmental activities since India does not form part of the NATO alliance. The inclusion of these modern weapon platforms has further highlighted the need for net-centric operations for their optimal exploitation. Technically seen, the signing of COMCASA, BECA and LEMOA Agreements provide the much required and essential support framework for achieving net-centric warfare capability in true sense. Today, the Indo-Sino relationship in the pandemic year 2020 has evolved far beyond a one-off border incident. It may be more due to the discomfort caused by a well-orchestrated Chinese military buildup plan across the globe over the last two decades, which was being closely observed by the US and India.

Joint Operations

To date, India has inducted some of the most technologically advanced US manufactured platforms like P-8I maritime Anti-submarine Warfare (ASW) aircraft, AH-64E Apache attack helicopters, Chinook heavy-lift helicopters, C-17 Globemaster III heavy-lift military aircraft and a few more like the Naval MH-60R Seahawks etc. are to come in due course of time. The immediate augmentation of India's dwindling key Air warfare capabilities to establish air supremacy over Indian skies and to successfully penetrate the air-defence of a technologically advanced adversary are seen as important factors.



Ministry of External Affairs

The US is a market leader in developing contemporary military technologies and these platforms are not only potent weapon systems but also highly capable net-centric warfare platforms, with such specialized features inherently built into the equipment design to enhance platform effectiveness. In other words, we may say that these platforms are highly C4I (Command, Control, Communications, Computers and Intelligence) enabled and their real capabilities only comes to the fore when exploited as Net Units in a larger multi-dimensional (land, air, sea, space and cyber) operations.

To quote an example, P-8I aircraft are true C4I airborne platforms and a force multiplier for the Indian Navy. These aircraft are not only individually highly capable to hunt down any hostile submarine but intrinsically capable of forming part of any fleet-level operations in the role of ASW screen since a submarine detection operation is a high air power-intensive activity. P-8Is are multi-mission aircraft with roles like surveillance, EW and are potent with air to surface missile capabilities. For their role, P-8Is have specialized radars for maritime, coastal and land surveillance using SAR (Synthetic Aperture Radar) and ISAR (Inverse Synthetic Aperture Radar) installed onboard.

The US DSCA (Defence Security Cooperation Agency) has approved the sale of AGM-84L Harpoon Block II air-launched missiles to India for P-8I aircraft. These missiles are not only designed for marine operations but can also destroy coastal and inshore assets, and thus suitable for contributing to tri-services joint operations. However, to transition from platform-centric to network-centric capabilities, India requires the onboard dedicated Tactical Datalink to activate the inter-operability features.

US military equipment manufacturers are some of the leading suppliers of the latest military hardware in the world and inter-operability is always a built-in standard design feature in their systems. However, India was unable to exploit such advance features since it required the support of COMCASA and BECA primarily and LEMOA in the support role. Indian Army, Navy and IAF have overlapping responsibilities in many areas of operations. For example, a joint air defence approach to make Indian skies impenetrable against fighter jets and hostile missiles require not only optimization of resources but also the real-time transmission of fast-moving air target tracks to effectively create a multi-layered air defence shield. Also, to be able to successfully operate with NATO forces, interoperability is a critical requirement. The requirement remains as and when Indian armed forces participate in exercises like Malabar etc., or other future combined multinational task force exercises. In today's geopolitical environment, threat scenarios can rapidly evolve, and joint operations with NATO forces as per standard C4I concepts shall be a minimum requirement for active deployment of Indian resources.

COMCASA

The Communications Compatibility and Security Agreement (COMCASA) framework for the interchange of encrypted communication between India and US militaries shall assist in the inter-operability in the air, sea, land, space and underwater domains. Even though India has developed its own tactical datalink indigenously, each service has its own independent programme and thus, indigenous data links are unable to communicate data amongst each other. Meanwhile, the US exploits Link-16/Link-11 systems for tactical data communication and the same is in use by all NATO forces. This standardisation of inter-platform communication ensures optimum exploitation of the NATO resources. However, for achieving joint operations capability with Indian forces either India can retrofit Link-16 equipment on all its platforms or work out an innovative solution as Indian datalinks are indigenously designed and developed. However, the present immediate option may be the fitment of Link 16 equipment since tactical datalink development is an activity which can take a couple of years to produce a stable product.

BECA

The Basic Exchange and Cooperation Agreement for Geo-Spatial Cooperation (BECA) relate to GEOINT (Geospatial Intelligence) data exchange information like the specifications and procedures for the information collection and processing. The GEOINT process assists in the identification of the geographic location and other features on Earth. The focus is primarily to analyse imagery and geospatial information in the context of earth-based geographical references.

This process is highly scientific and uses statistical data, remote sensing tools, Mapping and Survey information. Overall, for India, the BECA agreement shall have multiple implications, however, technically it shall help India overcome the gaps in India's own GEOINT data reference system. The Indian system is based on initial Everest Datum and then WGS84 Datum and is not considered suitable for an effective Multi-Platform Multi-sensor Data Fusion (MPMSDF) technology. MPMSDF is an essential feature for obtaining situational awareness capabilities for joint operations on a battlefield. BECA further ensures that the warfighting data being communicated over the Tactical Data Link is error-free and primarily based on a common Geo Reference System.

LEMOA

Logistics Exchange Memorandum of Agreement (LEMOA), on the other hand, is more related to the upkeep and maintenance of the resources of both countries in each other's facilities.

It may be termed more of a logistic support arrangement for re-fuelling, replenishment and repair of military platforms in each other's countries. This could be of far greater advantage to US forces operating in the Indian subcontinent region since India's maritime geography is most suitable for the US to create a deterrence to China. The launch of any US operations against China through the vast open Pacific Oceans exposes the resource movements to space-based Chinese surveillance. Also, the Pacific is a very large ocean to create repair and recovery facilities available to a battle-damaged platform. This disadvantage surely makes Indian subcontinent and the IOR region, the most suitable choice for the US to initiate any operations against China.

With these three primary agreements viz. COMCASA, LEMOA and BECA, Indians are better poised (against China) in the region around Indian sub-continent and IOR. These agreements shall also boost the Indian military forces' technological modernisation initiatives. Indian Defence forces may evolve from a defensive role to an aggressive-deterrence role where Indian Army, Navy and IAF operate under a Joint Command, which can be considered as an inevitable evolution, long overdue.

Conclusion

The three agreements have direct implications on the Concept of Operations (CONOPS) of the Indian Armed Forces since in any operational scenario, each of the weapon platform's survivability against physical attacks is an important factor. The threat here is computed based on the accurate and reliable view of the environment coupled with an intelligent Situational Awareness. COMCASA, LEMOA and BECA agreements, as a package. It shall assist in threat evaluation and resource deployment mechanisms to counter any adversary. The BECA supplied GEOINT information used at a Theatre level shall assist in finalising the force protection measures for each of the platforms against all perceived and emanating threats.

Threat perspicacity forms the core of every C4I system and therefore, India may consider Theatre level C4I systems implementation, preferably developed using Artificial Intelligence tools. On the other hand, Software Defined Radio (SDR) systems can evolve as an integral solution for the indigenous tactical data link equipment. Further, achieving a 9 'G' aircraft tracker and track transfer of such fast-moving real-time air track coordinates for missile launch can form part of this charter.

For BECA, the rapid development of existing indigenization efforts by ISRO in terms of space segment and ground segment infrastructure for accurate GEOINT information is required. ISRO's NavIC (Indian Regional Navigation Satellite System) and GAGAN (GPS Aided Geo Augmented Navigation) with SBAS (Satellite Based Augmentation System) need to be operationalized for military-level data accuracy (Restricted Services) at the earliest. NavIC is India's Global Navigation Satellite System (GNSS) based on a dual-frequency use for better accuracy. The main objective of NavIC is to provide accurate and reliable Position, Navigation and Timing services to users in India as well as the region extending up to 1500 km beyond Indian boundaries. The research on various corrections for applications demanding real-time high-precision positioning requires more focus, especially for uncertainties due to equatorial plasma bubbles and Space weather storms.

The three Indo-US Agreements may be seen more as facilitators for the Prime Minister's Atmanirbhar (self-reliance) policy that provide the impetus to India's self-reliance in defence. Here, a non-DRDO model based on a defence PSU along with private industry participation may be a workable solution due to niche talent required for such systems. The implementation of the COMCASA, LEMOA and BECA in its true spirit shall also require intensive resource planning and adequate training of personnel for use and maintenance of the associated technologies by all the three services.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or position of BharatShakti.in)

<https://bharatshakti.in/evolving-indo-us-co-operative-engagement-scheme-beca-comcasa-lemoa/>

Thu, 12 Nov 2020

“Revolutionary change” expected from new Indian space policy

By Andrew Jones

Helsinki: A draft policy on opening up India’s space sector is expected to bring transformational change, the chairman of the commercial arm of the Indian space agency said Nov. 10.

Speaking during an interview at Euroconsult’s World Satellite Business Week Virtual Edition conference, chairman and managing director of Antrix Corp. Rakesh Sasibhushan said the Spacecom Policy draft promises “revolutionary change.”

“The activities will never be the same again,” he said. The changes will allow access to a range of areas including satellite communications capacity, while private launch vehicle companies will be able to launch from ISRO’s facilities. “The complete ecosystem is accessible.”

The draft Spacecom Policy 2020 was published mid-October and was open to comments until Nov. 4. The draft act is under consideration and is expected to be put in place in the next few months, but timing will be down to the legislative process.



Launch of PSLV-C40 from Satish Dhawan Space Center in January 2018. Credit: ISRO

INSPACE, a new regulatory and space promotion organization announced in June part of reforms to increase space sector participation, will facilitate interaction between ISRO and the private sector. This will include access to satcom capacity, access to launch, to facilities and the whole ecosystem. INSPACE is expected to be in place in the next few months, Sasibhushan said.

Sasibhushan also stated that further policies addressing Earth observation, navigation, launch and many other areas are already under preparation, which will further transform the industry.

Antrix itself is also considering how to play a larger role, particularly how to align and partner with industry to boost the space sector.

“Until now the private sector was largely working with ISRO in a subcontractor role and there was no independent space actor outside ISRO. But as I see it many industries are keen to enter the commercial space domain on their own and are actively discussing their partners for technology funding, et cetera.”

Foreign direct investment will also be important in the new ecosystem. “Considering the lack of space technology players in the Indian private sector, international partnerships are important for giving a filip to commercial growth,” Sasibhushan says, adding that ISRO is also looking at technology transfers.

Asked about specific sectors, Sasibhushan says he sees big opportunities for Earth observation data, noting huge requirements for national security and the sectors of mining and land resources sectors expected to request a lot of services. This apparent demand would require dedicated space assets to be put in place.

Despite a strong global environment for commercial space activities, Sasibhushan perceives space for an Indian actor to come in and provide services. “India is a big country, there’s huge

demand and a full end-to-end system which is made and then deployed will have enough scope for exploiting the market in India.”

The main challenges in EO include a lack of capacity and high prices. “These are the two areas we need to address immediately and we are working, on an end-to-end basis, how we can partner Indian industries and put in space assets and provide end-to-end services with affordable costs so that the market will be very much interested.”

India is now beginning to resume activities following a big slowdown due to the COVID-19 outbreak, with Sasibhushan noting that India and ISRO had been hit hard by the pandemic. Launch activities have only just resumed with the launch of PSLV-C49 over the weekend. The previous launch was in December 2019.

“Things are improving. The COVID curve is coming down and the first flight after the pandemic strike was scheduled this weekend. Hopefully a full recovery will take place sooner [rather] than later.”

<https://spacenews.com/revolutionary-change-expected-from-new-indian-space-policy/>



Thu, 12 Nov 2020

Method to predict the atomic structure of sodium-ion batteries

Researchers from the Chinese Academy of Sciences and Delft University of Technology (TU Delft) have developed a method to predict the atomic structure of sodium-ion batteries. Until now, this was impossible even with the best supercomputers. The findings can significantly speed up research into sodium-ion batteries. As a result, this type of battery can become a serious technology next to the popular Li-ion batteries found in our smartphones, laptops and electric cars. The researchers have published their findings in the journal *Science*.

Mobile phones, laptops and electric cars all contain lithium-ion batteries. In terms of performance and energy density, these batteries are unrivaled. Yet the commercial dependence on one type of battery also has its disadvantages. Take cobalt, for example. So far, despite a great deal of research, producing lithium-ion batteries without this rare resource has not been possible. Cobalt is almost exclusively mined in Congo under harsh conditions and with a major impact on the environment.



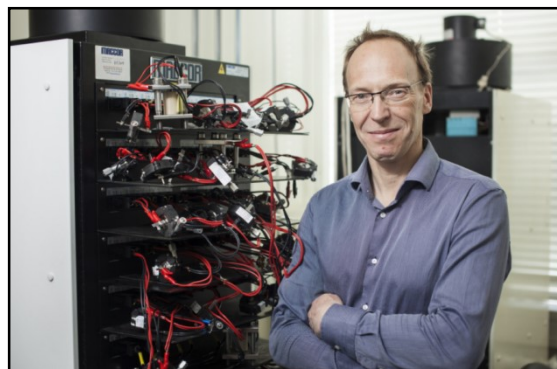
Credit: TU Delft

Lithium is a resource that can become problematic in the long run. "At the moment, we have more than enough of it," says TU Delft researcher Marnix Wagemaker. "But if we are all going to drive electrically in the future and if we need large batteries for storing solar energy at home, we will also need an enormous amount of lithium." That could become a problem because lithium reserves are anything but infinite.

Kitchen salt

Researchers believe sodium-ion batteries have potential. The name says it all: Instead of lithium, this type of battery is based on sodium, which is found in kitchen salt, among other things. In theory, Na-ion batteries do not perform as well as Li-ion batteries, but the gap is not that big. Wagemaker says, "At lab scale, Na-ion batteries can reach an energy density that is only 20 to 30% lower than that of Li-ion batteries. So they are not competitive when it comes to mobile phones or electric cars. But for situations in which weight is slightly less important, for example in maritime applications or in vehicles that can be charged frequently, they can be a good alternative."

Na-ion batteries would also be suitable for stationary use, for example, in a power wall at home or in a battery park that stores wind and solar energy. In addition, Na-ion batteries provide more opportunities in the use of raw materials to build up better and cheaper positive electrodes. This versatility makes it much easier to get rid of cobalt, for instance, compared to the positive electrodes in Li-ion batteries. Cobalt is not only expensive but also poses an ethical problem from a standpoint of labor exploitation.



Credit: TU Delft

Ironically, this versatility is also the sodium-ion battery's curse. Li-ion batteries only work with a limited number of raw materials and material structures, and it is relatively clear what the best 'recipe' for a cathode is. Not so for Na-ion batteries. "Depending on the precise cocktail of elements, you will end up with subtle differences in the atomic structure of the positive electrode, which have a major impact on the battery's performance," Wagemaker explains. "With just a handful of elements, there are so many structural possibilities that even the fastest supercomputer can't predict how the different combinations will turn out. As a result, the development of new materials is slow."

At least, that has been the case up to now. But the Delft researchers and their Chinese colleagues have found a way to predict the ideal recipe for the cathode. At an atomic level, a cathode looks much like a sandwich: it is made up of several layers, with ions in between. "At first it seemed like the size of the ions determined the atomic structure," says Wagemaker. "But it soon became clear that that wasn't the only factor. The distribution of the electrical charge of the ions plays a pivotal role."

Geology

This was a crucial insight for the researchers because the ratio between the size of an ion and its charge, the so-called "ionic potential," is known to have predictive value. "In geology, this relationship has been used for decades to understand why, for instance, certain iron oxides are more soluble than others," says Wagemaker. "This can reveal something about the formation of certain strata of the earth, or about other geological processes."

The question was whether this relationship would also be useful on an atomic scale. It turned out that it was. The researchers developed a simple formula based on the ionic potential. "Using this formula we can predict which structure we will get at which ratio of a selection of raw materials," says Wagemaker. "The formula guides us through the enormous number of possibilities to the electrode materials that can deliver the best performance."

On the rise

The researchers also tested their formula by designing new materials. "We tried to make a cathode with the highest possible energy density, and one that you can charge very quickly," says Wagemaker. "In both cases, we succeeded. In terms of energy density we were right at the upper limit of what is possible. I like the fact that such a simple formula, based on a very old idea from geology, can make predictions on the atomic scale with such accuracy."

This research focused on one part of a battery: the cathode. A logical next step is to also look at other types of structures, both in electrodes and electrolytes for various types of batteries. Can this new approach also play a role there? Marnix Wagemaker thinks so. "We are going to explore that in the coming period. With this research we hope to speed up the development of materials for next generations of batteries."

More information: Zhao et al., Rational design of layered oxide materials for sodium-ion batteries. *Science* (2020), DOI: [10.1126/science.aay9972](https://doi.org/10.1126/science.aay9972)

Journal information: [Science](https://www.science.org)

<https://phys.org/news/2020-11-method-atomic-sodium-ion-batteries.html>

New research explores the thermodynamics of off-equilibrium systems

Almost all truly intriguing systems are ones that are far away from equilibrium—such as stars, planetary atmospheres, and even digital circuits. But, until now, systems far from thermal equilibrium couldn't be analyzed with conventional thermodynamics and statistical physics.

When physicists first explored thermodynamics and statistical physics during the 1800s, and through the 1900s, they focused on analyzing physical systems that are at or near equilibrium. Conventional thermodynamics and statistical physics have also focused on macroscopic systems, which contain few, if any, explicitly distinguished subsystems.

In a paper published in the journal *Physical Review Letters*, SFI Professor David Wolpert presents a new hybrid formalism to overcome all of these limitations.

Fortunately, at the turn of the millennium, "a formalism now known as nonequilibrium statistical physics was developed," says Wolpert. "It applies to systems that are arbitrarily far away from equilibrium and of any size."

Nonequilibrium statistical physics is so powerful that it has resolved one of the deepest mysteries about the nature of time: how does entropy evolve within an intermediate regime? This is the space between the macroscopic world, where the second law of thermodynamics tells us that it must always increase, and the microscopic world where it can't ever change.

We now know it's only the expected entropy of a system that can't decrease with time. "There's always a non-zero probability that any particular sample of the dynamics of a system will result in decreasing entropy—and the probability of shrinking entropy grows as the system gets smaller," he says.

At the same time that this revolution in statistical physics was occurring, major advances involving so-called graphical models were being made within the machine learning community.

In particular, the formalism of Bayesian networks was developed, which provides a method to specify systems with many subsystems that interact probabilistically with each other. Bayes nets can be used to formally describe the synchronous evolution of the elements of a digital circuit—fully accounting for noise within that evolution.

Wolpert combined these advances into a hybrid formalism, which is allowing him to explore thermodynamics of off-equilibrium systems that have many explicitly distinguished subsystems coevolving according to a Bayes net.

As an example of the power of this new formalism, Wolpert derived results showing the relationship between three quantities of interest in studying nanoscale systems like biological cells: the statistical precision of any arbitrarily defined current within the subsystem (such as the probabilities that the currents differ from their average values), the heat generated by running the overall Bayes net composed of those subsystems, and the graphical structure of that Bayes net.

"Now we can start to analyze how the thermodynamics of systems ranging from cells to digital circuits depend on the network structures connecting the subsystems of those systems," says Wolpert.

More information: David H. Wolpert. Uncertainty Relations and Fluctuation Theorems for Bayes Nets, *Physical Review Letters* (2020). DOI: [10.1103/PhysRevLett.125.200602](https://doi.org/10.1103/PhysRevLett.125.200602)

Journal information: [Physical Review Letters](#)

<https://phys.org/news/2020-11-explores-thermodynamics-off-equilibrium.html>



Mira the star. Credit: NASA

Researchers make theoretical prediction of 2-D semiconductor tin dioxide

By Zhang Nannan

Recently, Prof. Zheng Xiaohong's research group from the Institute of Solid State Physics (ISSP) of the Hefei Institute of Physical Science (HFIPS) predicted a new two-dimensional (2-D) tin dioxide (SnO_2) monolayer phase ($P-4\text{ m}^2$) via first-principles calculations.

Bulk SnO_2 is an important n-type wide-bandgap ($\sim 3.6\text{ eV}$) semiconductor and is widely used as electrode materials, chemical sensor components, etc. but systematic study of possible tin oxide phases in 2-D is still missing. In particular, given the claims of magnetism in SnO_2 thin films, it is worth investigating whether a stable SnO_2 2-D phase can be synthesized or magnetism can be induced.

In this research, the researchers provided direct evidence of a stable and new 2-D phase of SnO_2 ($\delta\text{-SnO}_2$) with auxetic properties based on density functional theory method, which was impressive for its negative in-plane Poisson's ratio and high electron mobility.

In addition, they found double Mexican-hat-like band edges near the Fermi level presented by the valence band structure of SnO_2 and therefore a ferromagnetic phase transition and half-metallic ground state could be induced by hole doping within a very wide concentration range.

They also proved that SnO_2 monolayer could be tuned to be either an XY magnet or an Ising one, with a magnetic critical temperature above room temperature at proper hole concentrations.

All the above findings indicated that the predicted 2-D phase of SnO_2 provided a new example of rare p-type magnetism and a potential candidate material for spintronic applications.

More information: Peng Jiang et al. Computational prediction of a two-dimensional semiconductor SnO_2 with negative Poisson's ratio and tunable magnetism by doping, *Physical Review B* (2020). DOI: [10.1103/PhysRevB.102.195408](https://doi.org/10.1103/PhysRevB.102.195408)

Journal information: [Physical Review B](https://phys.org/news/2020-11-theoretical-d-semiconductor-tin-dioxide.html)

<https://phys.org/news/2020-11-theoretical-d-semiconductor-tin-dioxide.html>

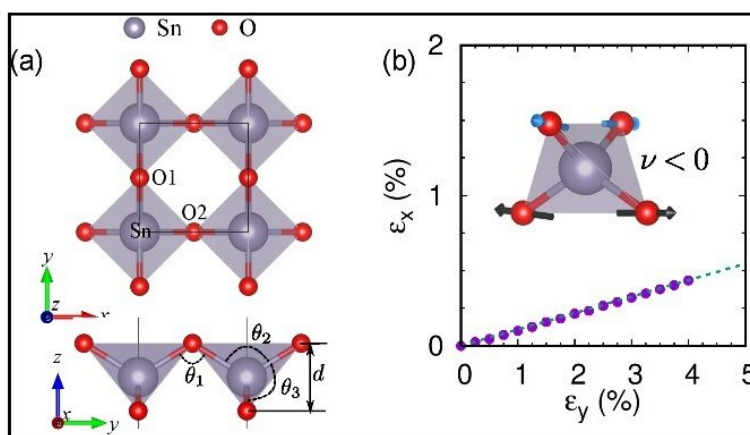


Fig. 1. (a) The atomic structure of a 2D $\delta\text{-SnO}_2$ monolayer. (b) The strain in the x direction resulting from an applied tensile strain in the y direction. Credit: JIANG Peng

Graphene electrodes for better-performance supercapacitors

By Zhang Nannan,

Recently, a research group led by Prof. Wang Zhenyang from the Institute of Solid State Physics of the Hefei Institutes of Physical Science (HFIPS) reported a novel method to prepare high-performance supercapacitors with ultra-high energy storage density.

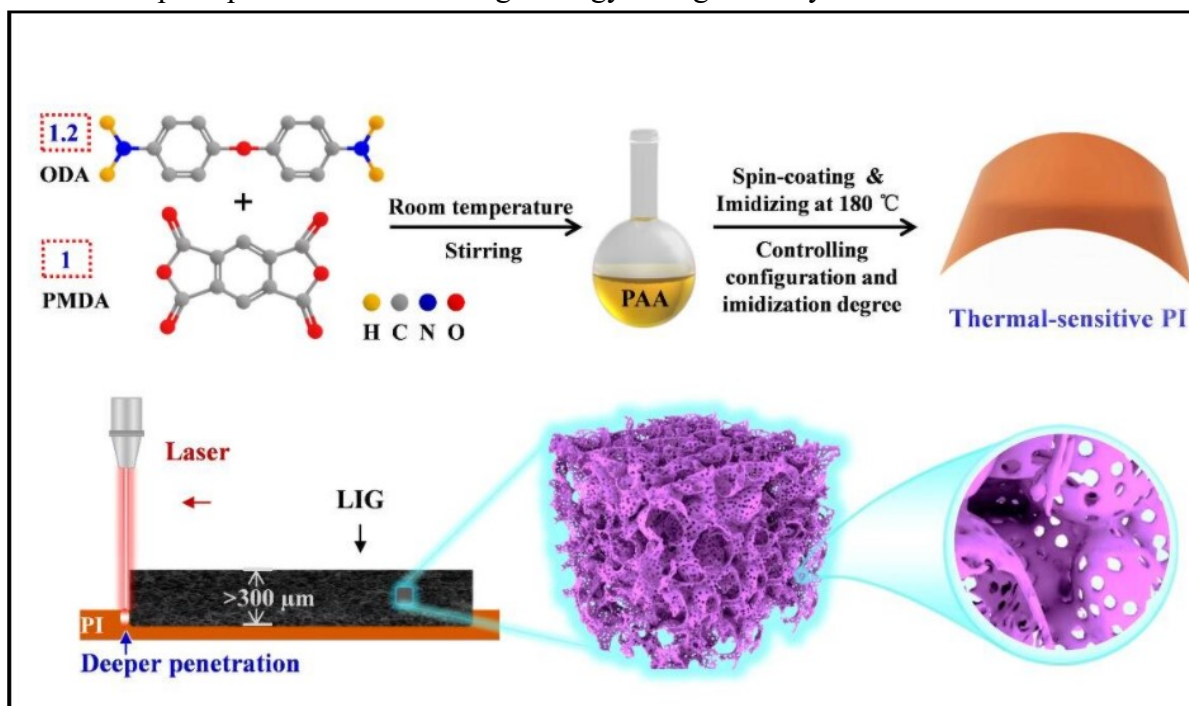


Fig.1. Schematic illustration for the improved laser inducing growth process of ultra-thick 3D graphene frameworks with hierarchical pores. Credit: LI Nian

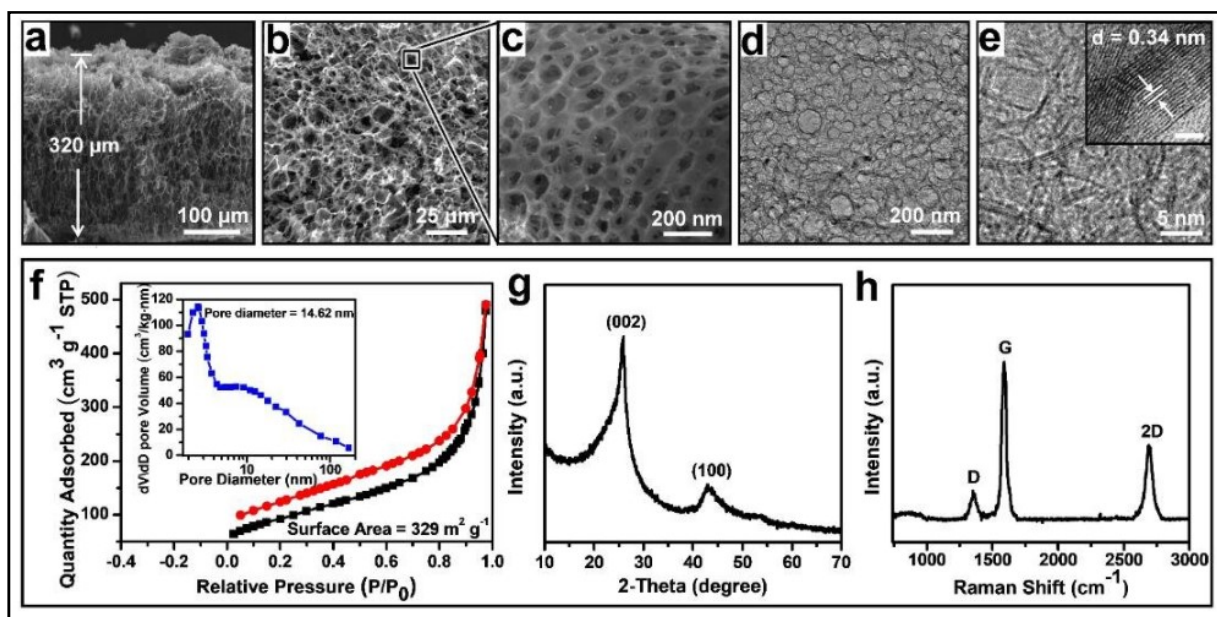


Fig. 2. Morphology and structure characterizations of the ultra-thick 3D graphene frameworks. Credit: LI Nian

Constructing 3-D graphene frameworks with ultra-thickness and rich ion transport paths is of great significance for the practical application of graphene supercapacitors. However, in thicker electrodes, the overall energy storage capability is limited by insufficient delivery of ions to the electrode material surface and the poor electron transport properties.

In this work, laser-induced ultra-thick 3-D graphene frameworks, with thickness up to 320 μm , were directly grown on the synthesized polyimide by optimizing the thermal sensitivity of polyimide to increase laser penetration depth. Thus, hierarchical pores were obtained due to the fast liberation of gaseous products during laser radiation, which facilitated fast ion transport.

This new structure well balanced the contradiction between electrode thickness and fast ion transport. Pseudocapacitive polypyrrole was further introduced into the graphene frameworks to prepare composite electrodes, which show specific capacitances as high as 2412.2 mF cm^{-2} at 0.5 mA cm^{-2} .

Accordingly, flexible solid-state micro-supercapacitors were constructed with a high energy density of 134.4 $\mu\text{Wh cm}^{-2}$ at a power density of 325 $\mu\text{W cm}^{-2}$.

These results show that these ultra-thick graphene electrodes hold great potential in the application of supercapacitors which promise high energy storage density.

More information: Xinling Yu et al. Ultra-thick 3D graphene frameworks with hierarchical pores for high-performance flexible micro-supercapacitors, *Journal of Power Sources* (2020). DOI: [10.1016/j.jpowsour.2020.229075](https://doi.org/10.1016/j.jpowsour.2020.229075)
<https://phys.org/news/2020-11-graphene-electrodes-better-performance-supercapacitors.html>

COVID-19 Research News



Thu, 12 Nov 2020

IISc researchers developing vaccines to treat COVID, HIV

Researchers at the renowned Indian Institute of Science (IISc) in this tech city are developing vaccines to treat Covid-19 and HIV (human immunodeficiency virus), an official said on Tuesday

Researchers at the renowned Indian Institute of Science (IISc) in this tech city are developing vaccines to treat Covid-19 and HIV (human immunodeficiency virus), an official said on Tuesday. "The researchers have developed a heat-tolerant Covid-19 vaccine candidate and a rapid method to identify specific regions on the HIV envelope protein that are targeted by antibodies, which can help design effective vaccines," said the official in a statement.

The institute's molecular bio-physics unit professor Raghavan Varadarajan is leading the team of researchers on developing the vaccines.

"The Covid-19 vaccine candidate contains a part of the spike protein of the novel coronavirus called the receptor-binding domain (RBD), the region that helps the virus stick to the host's cell," said the official.

The vaccine candidate is being developed in collaboration with Mynvax, a start-up, co-founded by Varadarajan and incubated at a lab in the institute.

"When tested in guinea pig models, the vaccine candidate triggered a strong immune response. It also remained stable for a month at 37 degree Celsius, and freeze-dried versions could tolerate temperatures as high as 100 degree Celsius," noted the statement.

Such 'warm' vaccines can be stored and transported without expensive cooling equipment to remote areas for mass vaccination although most vaccines need to be stored between 2-8AoC or even cooler temperatures to avoid losing their potency.

The difference between the vaccine being developed at the institute and other Covid vaccines is the former's candidate uses only a specific part of the RBD, a string of 200 amino acids instead of the entire spike protein.

The researchers inserted genes coding for this part via a carrier DNA molecule, called a plasmid, into mammalian cells, which churned out copies of the RBD section.

The team also found that the RBD formulation was as good as the full spike protein in triggering an immune response in guinea pigs but much more stable at high temperatures for extended periods.

"We have to get funds to take this forward to clinical development," said Varadarajan, adding it would include safety and toxicity studies in rats along with process development and GMP manufacture of a clinical trial batch before they are tested in humans.

As the studies can cost Rs 10 crore, the professor said the team might not be able to take it forward unless the government funded it.

The second study focused on HIV, the virus that causes AIDS, a disease for which there is no vaccine despite decades of research.

The team, including researchers from other institutes, sought to pinpoint which parts of the HIV's envelope protein are targeted by neutralising antibodies a' the ones that block virus entry into cells, not flag it for other immune cells to find.

"Vaccines based on these regions might induce a better immune response. To map such regions, researchers use methods like X-ray crystallography and cryo-electron microscopy though they are time-consuming, complicated and expensive," said the statement.

Hence, Varadarajan and his team mutated the virus so that an amino acid called cysteine would pop up in several places on the envelope protein. They added a chemical label to stick to these cysteine molecules and treated the virus with neutralising antibodies.

"In principle, researchers could adapt this methodology to any virus, including Covid-19," added the statement.

The studies were published in the "Journal of Biological Chemistry" and the "Proceedings of the National Academy of Sciences."

<https://www.indiatvnews.com/science/iisc-researchers-developing-vaccines-to-treat-covid-hiv-663944>

