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‘India wary of possible China, Pak collusion’

*The government had procured two squadrons of Rafales,
which are considered 4.5 generation aircraft*

By Elizabeth Roche

New Delhi: The integration of fifth and sixth generation technologies into 114 aircraft manufactured in India for the Indian Air Force will be a key consideration while selecting vendors for the mega deal, India’s new air force chief Vivek Ram Chaudhari said on Tuesday.

Addressing the annual press conference ahead of Indian Air Force’s raising day on 8 October, Chaudhari also said despite plans to procure 114 multi-role fighter aircraft (MRCA) and placing orders for 83 indigenously built light combat aircraft (LCA) besides some other procurements, the IAF would still be short of the sanctioned strength of 42 fighter squadrons required for a two front war with Pakistan and China. The realistic number of squadrons India could have would be around 35 till the next decade, he told reporters.

“We would be around 35 fighter squadrons by the next decade in view of the phasing out of old aircraft and induction of new aircraft,” he said.

Chaudhari added that India will get delivery of Russian-made S-400 surface-to-air missile defence system “within this year” as he spoke of IAF’s preparedness to meet 21st century challenges and other threats. It was in October 2018 that India had signed the \$ 5.43 billion deal with Russia for five S-400 regiments.



Air chief marshal Vivek Ram Chaudhari said that 114 fighter aircraft would be made under the ‘Make in India’ initiative.

Responding to a question whether the 114 fighter aircraft would be built by an Indian firm with a foreign equipment manufacturer under the strategic partnership model, Chaudhari said the jets would be made under the “Make in India” initiative. But he added that the successful bidder would be chosen on the basis of their product being able to integrate 5th and 6th generation technologies including sensors, avionics and weapon systems. One of the “key requirements” of the IAF would be “the ability of the aircraft to integrate 5th and 6th gen technology,” he said.

The IAF’s main work horse, the Russian made Sukhoi MKI, is a fourth generation aircraft. New Delhi has procured two squadrons or 36 Rafales from France that are considered 4.5 generation aircraft. For its 5th generation aircraft, the IAF is banking on the homegrown Advanced Medium Combat Aircraft (AMCA) that is being developed by the Defence Research and Development Organisation. The AMCA is expected to enter combat service with the IAF in the early years of the next decade, Chaudhuri said in response to a question as to how India planned to take on strategic rival China’s building up of its air force.

Chaudhuri said India was concerned about possible collusion between China and Pakistan on the technology front, in the backdrop of reports of Pakistani army officers being posted to Chinese army’s Western, Southern Theatre Commands as part of an intelligence sharing exercise. “The

only issue that concerns us is information of Western technology which passes hands from Pakistan to China," the IAF chief said.

When asked if India was concerned about China developing military infrastructure along the Line of Actual Control border, Chaudhari said China's capability to launch multiple high altitude missions would remain weak.

"The induction of (French made) Rafale, (US made) Apaches have significantly added to our combat potential. Our offensive strike capability has become even more potent with the integration of new weapons on our fleets," the IAF chief said.

He added that the IAF is keen on integration among the armed forces. The joint planning and execution of operations by the three services should result in the maximum increase in India's net combat capability, the IAF chief said. India is looking at creating theatre commands to integrate capabilities of the three services and to ensure best utilisation of scarce resources.

<https://www.livemint.com/news/india/india-could-have-35-squadrons-till-next-decade-short-of-42-required-iaf-chief-11633436785028.html>



Wed, 06 Oct 2021

Not possible to reach 42 fighter squadrons in next 10-15 years: IAF Chief

'China building airfields in high altitude but they have huge penalty of high altitude'

By Dinakar Peri

New Delhi: It is not possible for the Indian Air Force (IAF) to reach the sanctioned strength of 42 fighter squadrons in the next 10-15 years and the force will remain at 35 squadrons, given the current phaseouts and inductions, according to Chief of the Air Staff Air Chief Marshal (ACM) V.R. Chaudhari.

Addressing the annual press conference on Tuesday ahead of the Air Force Day on October 8, he said that deliveries of the S-400 Surface to Air Defence (SAM) systems from Russia were on track, but cautioned that SAM systems could not be a replacement for fighter jets.

"The four squadrons of Light Combat Aircraft (LCA)-Mk1A, six squadrons of the Advanced Medium Combat Aircraft (AMCA) and six Medium Role Fighter Aircraft (MRFA), and then factoring in the phaseout, it will remain at 35 squadrons in the next decade. There is no scope for increment as of now," he stated.

The Force has an authorised strength of 42 fighter squadrons to tackle a twin threat from China and Pakistan.

S-400 induction

Responding to questions, he remarked that the first S-400 regiment should be inducted within this year. Asked if the requirement of fighter jets could be offset by the long range S-400, he observed that one shouldn't make a balance here because the S-400 or any other SAM system were defensive weapon systems. "We need a balance of strike aircraft which can penetrate deep into enemy territory to deliver ordnance."

Elaborating on force modernisation, he disclosed the last four MiG-21 squadrons would be phased out in the next four years. Owing to the draw down of the MiG-21s, and the Jaguars,



Air Chief Marshal Vivek Ram Chaudhary addresses the media in New Delhi on October 5, 2021. | Photo Credit: R.V. Moorthy

Mirage-2000 and MiG-29s going out by the end of decade, the accretion plan was mainly based on firstly the 83 LCA Mk-1A, for which the contract was signed last year and deliveries would commence by 2024.

“We are fully committed to the AMCA programme, for which an ambitious timeline has been set by DRDO themselves. The AMCA will roll out well before the end of this decade. We hope to start inducting the AMCA by the early years of next decade,” he stressed. However, to mitigate the gap in fighter squadrons and the combat capabilities, the Request For Information (RFI) for 114 MRFA was floated. “The RFI were received and we are now awaiting to move the case up further”, he noted.

China, Pak cooperation

On the military cooperation between China and Pakistan, he remarked that their only concern was “dissemination of information of western tactics and technology which passes hands from Pakistan to China... We are prepared to handle a two-front contingency”.

On China’s continued military and infrastructure build-up along the Line of Actual Control (LAC), he pointed out that China continued its deployment at three airbases in the Tibet region. “We’re fully prepared to deal with any situation. We need to keep in mind that while they have built airfields and hardened their shelters, they have the huge penalty of high altitude. That will be a weak area for them.”

Reiterating the IAF’s full commitment to integration among the Services, he emphasised that joint planning and execution of operations by the three Services would result in a maximum increase in the net combat capability.

On formation of integrated theatre commands, he reiterated, “Theatreisation needs to be done keeping in mind future warfare. Should be synchronised. Doctrines and strength of each service need to be kept in mind.”

<https://www.thehindu.com/news/national/not-possible-to-reach-42-fighter-squadrons-in-next-10-15-years-iaf-chief/article36845750.ece>

THE TIMES OF INDIA

Wed, 06 Oct 2021

GU, DRDO sign MoU for Rs 100cr cybersecurity research centre

Ahmedabad: Gujarat University (GU) has signed a Memorandum of Understanding (MoU) with the Defence Research and Development Organisation (DRDO) to establish an advanced technology centre, Sardar Vallabhbhai Patel Centre for Cybersecurity Research (SVPCCR), at the GU campus in Ahmedabad.

The centre will be established with an investment of over Rs 100 crore, according to a media release from GU.

The MoU was inked in the presence of defence minister, between the secretary of the department of defence R&D, DRDO chairman Dr G Satheesh Reddy and GU vice-chancellor Himanshu Pandya, in New Delhi on Monday.

The centre will undertake directed basic and applied research in broad domains related to defence and dual-use applications.

<https://timesofindia.indiatimes.com/city/ahmedabad/gu-drdo-sign-mou-for-rs-100cr-cybersecurity-research-centre/articleshow/86794003.cms>



Developing indigenous technology need of the hour: Defence Minister Rajnath Singh

Developing new technologies indigenously is the need of the hour, said Defence Minister Rajnath Singh pointing out that it is extremely important not just for strengthening national security but also ensuring overall development of the country

New Delhi: Developing new technologies indigenously is the need of the hour, said Defence Minister Rajnath Singh pointing out that it is extremely important not just for strengthening national security but also ensuring overall development of the country.

Singh's statement came during felicitation ceremony of the winners of 'Dare to Dream 2.0' Contest of Defence Research and Development Organisation (DRDO) in New Delhi.

Singh gave away awards to 40 winners - 22 in Individual category and 18 in Startup category. He also launched 'Dare to Dream 3.0' to promote innovators & startups and provide a platform to the young ignited minds in the country.



Dare to Dream is DRDO's pan-India contest to promote Indian academicians, individuals and startups to develop defence and aerospace technologies and systems.

DRDO provides technical and financial support to the winners for realisation of their ideas under the Technology Development Fund (TDF) scheme.

Singh also gave away DRDO Young Scientists awards for the year 2019. Sixteen DRDO scientists, under the age of 35 years, were awarded for their outstanding contribution in areas of their expertise. During the occasion, Singh said they reflect the energy, enthusiasm and commitment of the youth of the country to create something new. He exuded confidence that the winners in the fields of innovation, design and development will inspire young minds and create path-breaking innovation in future.

The 'Dare to Dream' challenge, he said, represents the vision and mission of the government as also the mandate of DRDO. Singh reiterated the government's resolve to build a strong and self-reliant 'New India' which, he said, can only be achieved through a collaborative effort.

He termed 'effort' and not just 'desire' as the key for an individual, society and the nation to achieve success. Saying that India is one of the oldest countries in experience & culture and the youngest with about 60 per cent of the young population, he encouraged the youth to observe, learn & create new innovations and play their part in taking the country to greater heights. Pointing out that global security concerns, border disputes and maritime affairs have forced the world to focus on military modernisation, Singh reaffirmed the government's commitment to modernise the Armed Forces and equip them with latest machinery to deal with any challenge.

He described the power of the youth as the hope for the country and called upon the young ignited minds to help the government in achieving the objective of 'Aatmanirbhar Bharat'.

"Developing new technologies indigenously is the need of the hour. Our vision of 'Aatmanirbhar Bharat' is to ensure that advanced technologies are developed domestically. It is extremely important not just for strengthening national security but also ensuring overall development of the country," said Singh.

Describing private sector participation as crucial to achieving 'Aatmanirbhar Bharat', Singh stated that the government, led by Prime Minister Narendra Modi, has taken a series of reform steps to increase the participation of private industry in the defence sector which has created a suitable growth environment and provided a big boost to indigenous defence capabilities.

Singh commended DRDO Young scientists' lab and Advance technology Centres for working in futuristic technologies such as nano technology, quantum computing, artificial intelligence, unmanned and robotic technologies. Terming it as the new dimension of 'New India', he called for increased R&D efforts in such futuristic technologies. He stressed on the need to develop dual use technologies which can be beneficial for both Armed Forces personnel and civilians.

He urged all the stakeholders to focus on research and development in order to provide state-of-the-art equipment to the Armed Forces.

This will help in establishing the country's identity in the international market and achieving the vision of 'Make in India, make for the world', he said. (IANS)

<https://www.sentinelassam.com/national-news/developing-indigenous-technology-need-of-the-hour-defence-minister-rajnath-singh-557646>



Wed, 06 Oct 2021

अमेरिका के साथ अनोखे 'आईस्टार' सिस्टम पर काम कर रहा है भारत, एयर स्ट्राइक के बाद सबूत इकठ्ठा करने में मिलेगी मदद

साल 2019 में भारतीय वायुसेना ने जब पाकिस्तान के बालाकोट में आतंकी संगठन जैश-ए-मोहम्मद के ट्रेनिंग कैंप पर एयर स्ट्राइक की थी तो हमले के बाद की कोई तस्वीर या फिर वीडियो सामने नहीं आया था।

By: नीरज राजपूत

नई दिल्ली: बालाकोट एयर स्ट्राइक के करीब ढाई साल बाद भारतीय वायुसेना जंग के मैदान से जुड़ी जानकारी को पूरी तरह से इकठ्ठा करने के लिए अमेरिका के साथ खास इंटेलीजेंस और रेकोनाइसंस 'आईस्टार' सिस्टम पर काम कर रहा है। वायुसेना प्रमुख ने मंगलवार को इस बार में खुलासा किया है।

वायुसेना प्रमुख एयर चीफ मार्शल वीआर चौधरी ने एक सवाल के जवाब में संक्षिप्त बयान देते हुए कहा कि अमेरिका के साथ भारत का जो डिफेंस टेक्नोलॉजी एंड ट्रेड इनिशियेटिव (डीटीटीआई) करार है, उसके तहत दोनों देश अब आईस्टार यानि इंटेलीजेंस, सर्विलांस टारगेटिंग एंड रेकोनाइसंस पर काम कर रहे हैं।



वायुसेना प्रमुख एयर चीफ मार्शल वीआर चौधरी

एयर स्ट्राइक के बाद सबूत इकठ्ठा करने में मिलेगी मदद

इस आईस्टार सिस्टम के जरिए वायुसेना पूरी रणभूमि पर न केवल नजर रख सकेगी बल्कि जंग के बाद के हालात की जानकारी भी इकठ्ठा कर सकेगी। यानि अगर किसी को जंग या फिर किसी एयर स्ट्राइक या फिर ऑपरेशन से जुड़ा सबूत चाहिए होगा तो वो भी इस 'सिस्टम ऑफ द सिस्टम' से मिल सकेगा। डीआरडीओ भी इस तरह के सिस्टम पर काम रहा है।

माना जा रहा है कि भारतीय वायुसेना के एयर बोर्न अर्ली वॉर्निंग सिस्टम (एवैक्स) और नेत्रा सिस्टम की तरह ही किसी विमान पर लगाया जाएगा। इन दोनों टोही विमान को भारतीय वायुसेना कमांड एंड कंट्रोल

सेंटर की तरह इस्तेमाल करती है। लेकिन, ये दोनों सिस्टम (एवैक्स-फालकन और नेत्रा) सिर्फ एयर-स्पेस की सर्विलांस और निगरानी के लिए इस्तेमाल किया जा सकता है, लेकिन इनसे सबूत इकठ्ठा नहीं किए जा सकते हैं।

आपको बता दें कि साल 2019 में भारतीय वायुसेना ने जब पाकिस्तान के बालाकोट में आतंकी संगठन जैश-ए-मोहम्मद के ट्रेनिंग कैंप पर एयर स्ट्राइक की थी तो हमले के बाद की कोई तस्वीर या फिर वीडियो सामने नहीं आया था।

<https://www.abplive.com/news/india/india-to-cooperate-with-us-on-istar-system-balakot-type-strike-will-have-evidences-too-ann-1978243>

नवभारत टाइम्स

Wed, 06 Oct 2021

दुनिया में 'ब्रह्मास्त्र' पाने की लगी होड़, परमाणु बम से लैस भारत के लिए क्यों है जरूरी?

हाइलाइट्स

- उत्तर कोरिया से लेकर रूस तक हाइपरसोनिक मिसाइलों के परीक्षण का दौर तेज हो गया है
- हालत यह है कि अमेरिका खुद भी लगातार हाइपरसोनिक मिसाइलों के विकास में लगा हुआ है
- वहीं भारत का सबसे बड़ा दुश्मन चीन हाइपरसोनिक मिसाइलों की तैनाती करने में जुटा हुआ है

सोल/ मास्को: उत्तर कोरिया से लेकर रूस तक दुनियाभर में हाइपरसोनिक मिसाइलों के परीक्षण का दौर तेज हो गया है। हालत यह है कि अब तक इस तकनीक से परहेज करने वाला अमेरिका खुद भी लगातार हाइपरसोनिक मिसाइलों के विकास में लगा हुआ है। वहीं भारत का सबसे बड़ा दुश्मन चीन हाइपरसोनिक मिसाइलों की तैनाती करने में जुटा हुआ है। आधुनिक 'ब्रह्मास्त्र' कहे जाने वाली हाइपरसोनिक मिसाइलों के आने से दुनिया में हथियारों की अब एक नई रेस शुरू हो गई है। इस रेस में बने रहने के लिए भारत के लिए ब्रह्मास्त्र बनाना मजबूरी होता जा रहा है।



रूस का नया 'ब्रह्मास्त्र' S-500, अंतरिक्ष तक करेगा हमला

हिंदू धर्म में मान्यता है कि प्राचीन काल में ब्रह्मास्त्र एक ऐसा हथियार था जिसका कोई तोड़ नहीं था। एक बार वार करने पर शत्रु का नाश तय था। अब कुछ यही बात हाइपरसोनिक मिसाइलों के बारे में भी विशेषज्ञ कह रहे हैं। इसी वजह से इसे पाने की होड़ भी दुनिया में तेज हो गई है। किम जोंग उन की तानाशाही वाले उत्तर कोरिया ने हाल ही में हाइपरसोनिक मिसाइलों का परीक्षण किया है। इससे दुनियाभर में टेंशन बढ़ गई है। उत्तर कोरिया एक परमाणु हथियार संपन्न देश है और इस परीक्षण से वैश्विक परमाणु संतुलन बिगड़ सकता है।

हाइपरसोनिक मिसाइलों की क्यों दीवानी हुई दुनिया

इस बीच रूस ने भी सोमवार को अपनी जिरकॉन हाइपरसोनिक मिसाइल का पहली बार पनडुब्बी से सफल परीक्षण किया है। रूस हाइपरसोनिक मिसाइलों की रेस में सबसे आगे चल रहा है। इसके बाद चीन और अमेरिका का नंबर आता है। इन देशों के अलावा 5 अन्य देश हाइपरसोनिक मिसाइल बनाने में जुटे हुए हैं। इनमें भारत भी शामिल है। दरअसल, परंपरागत बलिस्टिक मिसाइल की तरह से ही हाइपरसोनिक

मिसाइलें भी परमाणु हथियार दागने में सक्षम हैं लेकिन उनकी स्पीड ध्वनि की रफ्तार से 5 गुना ज्यादा होती है।

यही नहीं परंपरागत मिसाइलों को अपने लक्ष्य तक पहुंचने के लिए अंतरिक्ष में ऊंचाई तक जाना होता है। इसके विपरीत हाइपरसोनिक मिसाइल वायुमंडल की निचली सतह पर उड़ान भरते हुए ज्यादा तेजी से अपने लक्ष्य पर हमला बोलती है। सबसे अहम बात यह है कि परंपरागत मिसाइलें धीमी गति से चलती हैं और उन्हें रेडॉर और एयर डिफेंस सिस्टम की मदद से ट्रैक करना आसान होता है। वहीं हाइपरसोनिक मिसाइल लगातार अपना रास्ता बदलती रहती है और इसकी स्पीड बहुत ज्यादा होती है जिससे उसे ट्रैक नहीं किया जा सकता है। बता दें कि अमेरिका, रूस, चीन समेत दुनिया के कई देशों ने परंपरागत मिसाइलों को ट्रैक करके उसे तबाह करने की क्षमता हासिल कर ली है। रूसी एस-400 एयर डिफेंस सिस्टम को दुनिया में सबसे अच्छा माना जाता है।

'आधुनिक ब्रह्मास्त्र' मचा सकता है ज्यादा तबाही

हाइपरसोनिक मिसाइलों की खासियत यह है कि यह परंपरागत बमों को भी अन्य मिसाइलों की तुलना में ज्यादा तेजी और सटीकता के साथ अपने लक्ष्य पर गिरा सकती हैं। हाइपरसोनिक मिसाइलें परमाणु बम भी गिराने में सक्षम हैं जिससे दुनिया में परमाणु युद्ध शुरू होने का खतरा पैदा हो जाएगा। हाइपरसोनिक मिसाइलों का खतरा अब दुनिया के सामने मुंह बाए खड़ा है। रूस, चीन, अमेरिका और अब उत्तर कोरिया ने हाइपरसोनिक मिसाइलों का परीक्षण किया है। अमेरिकी रिपोर्ट के मुताबिक फ्रांस जर्मनी, ऑस्ट्रेलिया, भारत और जापान हाइपरसोनिक मिसाइलों पर काम कर रहे हैं।

वहीं ईरान, इजरायल और दक्षिण कोरिया ने इस तकनीक पर मूलभूत शोध कर लिया है। रूस इन सबमें सबसे आगे है। रूस ने सोमवार को अपनी जिरकॉन हाइपरसोनिक क्रूज मिसाइल का परीक्षण किया था। इस मिसाइल को पहली बार पनडुब्बी से दागा गया था। अमेरिकी रिपोर्ट कहती है कि चीन बहुत तेजी से हाइपरसोनिक मिसाइलों पर काम कर रहा है। दोनों ने कुछ मिसाइलों को तैनात भी कर दिया है। अमेरिका भी अगले 5 साल में 40 परीक्षण करना चाहता है।

क्या परमाणु गेमचेंजर हैं हाइपरसोनिक मिसाइलें

विशेषज्ञों का कहना है कि इस मिसाइल के आने से वैश्विक परमाणु संतुलन नहीं बदलेगा लेकिन इसको दागने के लिए एक और प्रभावी हथियार दुनिया को मिल गया है। दुश्मन को यह पता नहीं चल पाएगा कि उसके ऊपर दागी गई हाइपरसोनिक मिसाइल परमाणु बम से लैस है या नहीं। अमेरिका ने माना है कि उसके वर्तमान मिसाइल डिफेंस सिस्टम हाइपरसोनिक मिसाइलों का पता लगाकर उसका खात्मा करने में सक्षम नहीं हैं। विशेषज्ञों ने कहा कि हाइपरसोनिक एक क्रांतिकारी बदलाव है लेकिन गेमचेंजर नहीं है।

हाइपरसोनिक मिसाइल दौड़ में कहा है भारत?

चीन के तेजी से हाइपरसोनिक मिसाइल बनाने से भारत के लिए बड़ा खतरा पैदा हो गया है। चीन लद्दाख में दादागिरी दिखा रहा है और उसने बड़े पैमाने पर हथियारों की तैनाती की है। ऐसे में भारत के लिए इस ब्रह्मास्त्र को पाना जरूरी हो गया है। भारत ने हाइपरसोनिक मिसाइल तकनीक के क्षेत्र में बड़ी छलांग लगाई है। अमेरिका, रूस और चीन के बाद भारत चौथा ऐसा देश बन गया है जिसने खुद की हाइपरसोनिक टेक्नोलॉजी विकसित कर ली और इसका सफलतापूर्वक परीक्षण भी कर लिया है। डिफेंस रिसर्च एंड डेवलपमेंट ऑर्गनाइजेशन (DRDO) ने ओडिशा के बालासोर में हाइपरसोनिक टेक्नॉलजी डिमॉन्स्ट्रेटर वीइकल (HSTDV) टेस्ट को अंजाम दिया। यह हवा में आवाज की गति से छह गुना ज्यादा स्पीड से दूरी तय करता है। यानी दुश्मन देश के एयर डिफेंस सिस्टम को इसकी भनक तक नहीं लगेगी।

सीधे शब्दों में कहें तो भारत के पास अब बिना विदेशी मदद के हाइपरसोनिक मिसाइल डेवलप करने की क्षमता हो गई है। रिपोर्ट्स के अनुसार, डीआरडीओ अगले पांच साल में स्क्रेमजेट इंजन के साथ हाइपरसोनिक मिसाइल तैयार कर सकता है। इसकी रफ्तार दो किलोमीटर प्रति सेकेंड से ज्यादा होगी। सबसे बड़ी बात यह है कि इससे अंतरिक्ष में सैटलाइट्स भी कम लागत पर लॉन्च किया जा सकते हैं। HSTDV के सफल परीक्षण से भारत को अगली जेनरेशन की हाइपरसोनिक मिसाइल ब्रह्मोस-II तैयार करने में मदद मिलेगी। फिलहाल उसे DRDO और रूस की एजेंसी मिलकर डेवलप कर रहे हैं।

<https://navbharattimes.indiatimes.com/world/rest-of-europe/russia-north-korea-china-testing-hypersonic-missiles-alarming-must-have-in-military-tech-for-india/articleshow/86774861.cms>



Wed, 06 Oct 2021

Forum Army 2021: Some salient points and takeaways

By Lt Gen (Dr) VK Saxena (Retd.)

What is Forum 2021?

International Military Technical Forum (called Forum in short) is an annual event organised and supported by the Ministry of Defence (MoD) of the Russian Federation. The 7th edition of this Forum titled 'Forum Army 2021' was held from 22-28 Aug 2021 at the Patriot Square and other locations in and around Moscow.

Like any other International defence show of this stature, the Forum provided multiple platforms featuring – equipment displays, air shows, unveiling new technologies, institutional platforms for interaction amongst Govt. officials, defence experts, scientists, exhibitors, media, industry reps, visitors and so on.

As always, at the bottom of the Forum was the 'business case' wherein, while the host eyed opportunities for multiple contracts (some 45 arms contracts were envisaged worth some 7 Bn USD), the international exhibitors (1316 exhibitors from 15 countries) tried to woo old and new customers to their freshly-minted/old-proven products for new/repeat orders. The media and industry got an update of 'what was brewing in the defence and aerospace technology domain.

This article takes a brief look at some of the new systems/technologies on display by Russia and more importantly, what are the takeaways/implications of the same for us.

New Russian Systems and Technologies at Display

All new Su-57E

Stealing the limelight at the air pavilion was the all new export version of the Russian Fifth Generation Fighter Aircraft (FGFA) Su-57E. It will be recalled that this machine, in its earlier version, was unveiled for the first time at International Aviation and Space Show in Moscow in Mar 2019.

The main point being projected for the new Su-57E (being put up as Perspective Multi role Fighter or PMF) was its tangible cost advantage vis-s-a-vis US FGFA's (F-35, F-22 etc.). The comparative tables on display attempted to convince the visitors that the machine had all the works on board – stealth, super-cruise, precise thrust vector control, adequate power on board, internal weapon bays and more (technical details of features not explained).



Forum Army 2021: Some Salient Points and Takeaways But Republicans are blocking funds for Human Infrastructure

Some Points for us

When India pulled out of the Russian FGFA programme in Jul 2018, there were performance sub-optimality issues besides other reasons (work share, time and cost overruns etc.). Our analysis had found the following main performance deficits at that time in Su-57E FGFA:–

- o Comparative thrust deficit which will put the aircraft at a one-on-one disadvantage while undertaking various actions/manoeuvres to out-perform an adversary in air combat.
- o Comparative deficit in super cruise capability (capability to undertake sustained supersonic flight with useful payload without having to fire the afterburners).
- o Inadequate stealth (mainly frontal stealth available as compared to all-aspect stealth features of F-22, F-35, J-20 etc. Consequently Su-57 had comparatively larger radar cross-section (RCS) and hence greater chances of detection by radar (if RCS of F-22 at certain reference parameter was 0.0001 m², the same for FGFA was assessed to be 0.1-1 m²). Su-57 had no internal weapon bays – a niche feature for all-aspect stealth.

While the Russians are now claiming that all the earlier performance blues stand addressed (higher thrust engine than the previous Saturn AL-41 F1S or Izdeliye 117, better thrust-to-weight ratio, better stealth features, mating with hypersonic missile etc.) it is for the prospective buyers to check it out. On our part we have to ensure that our very own FGFA, the Advanced Medium Combat Aircraft or AMCA does not suffer from any of the performance deficit which made us leave the FGFA programme in the first place. Big things have been promised in AMCA – all-aspect stealth, swing-role capability, fifth generation technologies to start with and provision to accept sixth generation capability upgrades, superior EW suit, internal weapon bays, full-pack armament suit etc. The HAL must walk the talk on its claimed capabilities.

Another big apprehension with AMCA is that it must not go the Tejas way with time and cost overruns running into decades and billions of dollars (sic). The first flight of AMCA is scheduled in 2025. HAL and ARDE must come good on this time frame. The not so encouraging news is that AMCA is behind schedule even as of now. HAL must catch up on time and cost.

Bas 200 Rotary wing Unmanned Aerial System (UAS)

Another interesting machine on display was the rotary wing UAS Bas 200. It will be recalled that this machine was first showcased in Jul 2021 during the International Aviation and Space Salon, MAKS 2021.

Currently most of the drone inventory world over is either quad/hexa-rotor for small drones and generally fixed wing for bigger machines. While China has reportedly developed helicopter swarm drones, mainframe rotary wing UAS in general are still comparatively lesser in number still date. To that end, it was something new at display.

Another interesting thing was that while Bas has a maximum take-off weight (MTOW) 200 kg, Russia plans to build this vertical to reach an MTOW of a whopping one ton. That indeed will be a niche development. OEM is Russian Helicopters Holdings.

Automated Thermal Acoustic Reconnaissance Vehicle

It was reported way back in 2017 that that Russia's Ruselectronics Group is developing advanced reconnaissance systems (named Penicillin) that can detect enemy artillery gun position within 5 seconds of the shot. The system is fully automated for the process of detection and adjusting own counter fire on the target. It uses both acoustic, as well as, thermal sensors. The vehicles were to go into production from 2019, post development.

It appears that this development has been completed as Forum 2021 exhibited a fully operational Automated Penicillin Reconnaissance system. The significance of this relatively new development is its extremely short time of response. It also will obviate the sub-optimality and risk associated with manual adjustment of artillery fire.

Counter Drone Systems

Learning through multiple combat situations in Syria where the Russians suffered the first ever swarm drone attack at their air base at Khmeimim and naval facility at Tartus, on 05th Jan

2018⁷ and later in the live battlefields of Nogorno-Kabarakh, Russians have come a long way in developing counter UAS (c-UAS) systems in the niche technology domain.

Some of these were at display first at iDEX 2021, and later, at Forum 2021. The emphasis was on soft-killing of UAS through the EW /RF route by electronically crippling the control/communication/navigation links of the drones or developing low-cost kill options using modified small arms (SA) or high-firing air defence guns. Some interesting displays included the following.

- o Borisoglebsk and Zhitel EW systems.
- o R-934 BMW automated jamming station.
- o Silok 01 EW system.
- o Repellent – Patrol EW system (jamming range claimed to be 20km).
- o Pole 21 advanced radio suppression systems.
- o Pishchal electromagnetic gun.(weight 3.5 kg, range 2 km).

Modified air defence guns with high rate of fire such as ZU-23-2 were also at display as counter-drone weapons in the kinetic kill domain.

Significance for us

The significance of seeing this weapon array is to realise which way the world is going in fielding all sorts of low-cost/EW kill/RF kill c-UAS arsenal. Also it is important to note, that we also have ZU 23-2 guns in large numbers. These must be put to effective use in counter-drone warfare. For this, the said guns will require to be upgraded. This project which is now hanging fire for 8 years must commence post haste. As regards soft-kill options, our Defence Research and Development Organisation (DRDO) and private industry need to go a long way ahead in this. The requirement is to move forward of just R&D and realise the products for operational use.

Anti-Stealth Systems

As the attacker takes pride in the ‘magic of invisibility’ by building new and newer stealth muscle on its aerial threat vehicles (plasma stealth, planform alignment, surface shaping, internal weapon bays, latest radar absorbent paints and more) the defenders are having the last laugh in building appropriate counter stealth technologies at comparatively miniscule costs.

On this concept, there were at display two Russian counter stealth radars (also called counter very low-observable or CVLO systems). Some points:-

- At the cutting edge today, the stealth as ‘invisible’ is being replaced by air-defenders by stealth as ‘low-observable’.
- Two CVLO radars at display were the latest version of the 55ZH6M Nebo M surveillance radar and the slightly vintage Struna 1/ Barrier –E radar.
- As per claims, these sensors are capable of detecting the order of stealth carried on cutting edge platforms like F-22, F-35 etc.

Significance for us

o The point to take home from this display is the realisation that the stealth threat is not on a distant horizon. It is knocking right at our door with China now possessing niche stealth platforms like Chengdu J-20 (Black Eagle), Shenyang J-31 Gyrfalcon and more.

o Accordingly, we need to develop CVLO platforms. Towards this following is needed:-

- The niche CVLO technologies are now in the domain of laser-based radars (called LIDARS) quantum radars, passive coherent location radars, electro-optical sensors, acoustic sensors and more.
- India is an independent and a proud radar house, where we can make every shade and genre of radar be it a fire control radar, missile guidance radar, early warning radar, tactical control radar, BMD radars, battlefield surveillance radar (BFSR), counter rocket and mortar radar (CRAM) more. We need to graduate to the CVLO technology domain. This is a challenge for DRDO and private industry.

Robotics in action

One of the special features of Forum Army 2021 was a Robotics competition. An entire pavilion was dedicated to the technologies for the control of UAS and robotics systems. There were combat and reconnaissance robots, robots designed for clearing the mines, robots for operating in the hazardous/contaminated areas etc. The controlling technologies embraced such niche areas as artificial intelligence, IT and ITes, virtual reality, augmented reality, 3D dynamic display and data transmission technologies etc.

On the UAS side, the emphasis was on showing a higher and higher degree of autonomy of the unmanned platforms to operate with minimal/nil connect with the ground control station and how the UAS can be used as a force- multiplier in joint missions with combat platforms in Manned and Unmanned Teaming (MUMT) operations.

Significance for us

We are into our baby-steps in robotics and just about entering the domain of MUMT related autonomous operations. A brief glimpse:–

o There is a series of DRDO's Daksh robots (Remotely operated vehicles or ROVs) which have been adapted for a variety of uses – identification and handling of IEDs, surveillance applications, confined space operations, automated driverless vehicles, mini UAVs (Netra), handling unexploded ordnances etc.

o Lately, during the Covid DRDO has come out with another adaptation of Daksh robot called Sewak for a variety of medical use.

o There is a sporadic presence of robots in defence public and private sector, namely for lifting/loading /stacking jobs or for taking on repetitive operations.

o There is a need to make more progress in this niche and fast emerging field.

Indian Defence Exports – Leaving Behind Old Mindset

Coming to the Indian pavilion one could feel a breadth of some fresh air upon realisation that some old mind-sets were finally being shed. This is further explained:–

o One of our most crippling mind-set has been that 'India does not have much exportables'.

o What else can otherwise explain our lack-lustre defence export performance wherein, in the last two financial years itself (2019-20 and 2020-21) our export figures have shown a dip from 9115.55 Crs to 8434.84 Crs.

o Of course, these figures are nowhere near the target figures of Rs 35000 Crs in defence exports by 2025 as laid down in the Draft Defence Production and Export Promotion Policy (DPEPP) 2020.

o Our defence export basket has, over the years been composed of mainly small-ticket and peripheral items (hardened armour plates, personal protective items, 5.56 mm cartridges, sleeping bags, bullet-proof vests, protective headgear helmets, bomb suppression blankets, radar parts/sub-assemblies, night-vision devices, Bharati radio, Kavach MOD II launcher, electronic systems mortar shell covers, ALH helicopter offshore petrol vessels, SU avionics, light engineering parts, coastal surveillance systems etc. Where are the big-ticket items? For that there has been an 'attitudinal block'.

o In a welcome departure to the above, the India pavilion had on display nearly all our exportable jewels:–

- Light Combat Aircraft Tejas.
- Akash Weapon system.
- Air defence fire control radar Atulya.
- 3D medium range surveillance radar Rohini.
- Airborne Early Warning and Control System (AEW&C).
- Beyond Visual Range Air-to-air Missile (BVRAAM).
- Identification Friend-or-Foe (IFF) system.

- Arjun Main battle tank Mk-1A.
- Advanced Towed Artillery Gun System (ATAGS).
- Anti tank guided missile NAG and HELINA.
- Joint venture protective carbine (JVPC).

It was nice to hear the Director of Public Interface (DPI) DRDO at the forum 2021 when he stated – ‘defence exports from India have a huge potential to grow further’⁵. It is a heartening to realise that the Govt’s attitude towards boosting defence exports is looking up.

That the Private industry will match the pace and go beyond is the hope of the author.

That was a brief round-up of Forum 2021 and some takeaways from it. The feel-good is that we are also there – arrived somewhere; reaching somewhere.

Good luck India!

<https://www.thenorthlines.com/forum-army-2021-some-salient-points-and-takeaways/>

COVID 19: DRDO’s Contribution



Wed, 06 Oct 2021

Power of technology is transforming the healthcare ecosystem: TS Singh Deo

The state has the capacity to vaccinate 1 to 1.5 crore patients every month and has so far vaccinated between 35-40 percent of the targeted population with dose 1 and 2, stated TS Singh Deo, Minister of Health and Family Welfare, Government of Chhattisgarh.

The state governments play a key role in India's health system, during the COVID crisis Information Technology (IT) has been helpful to take all necessary steps to ensure that we are prepared well be it the supply of drugs, vaccines and connect doctors in the urban areas to district health workers to extend guidance, noted the Chhattisgarh health minister.

Addressing the august gathering of healthcare leaders across the country at the Economic Times Healthcare Leaders Summit, T S Singh Deo, Minister of Health and family welfare, Government of Chhattisgarh spoke on the various measures being undertaken by his government to improve healthcare quality and access.



He stated that the state’s healthcare sector is better prepared to handle a health emergency like COVID than it was in 2020.

"The state has rampantly developed its testing capacity, medical healthcare centres including Community Health Centres (CHC) and primary health centres (PHC), Intensive Care Unit (ICU) beds and oxygen generating plants to ensure that the state is ready to deal with any covid wave in the future," Deo said.

Elucidating on the positive changes that the inculcation of Information Technology (IT) has brought forth in the health sector, he said, “IT has been helpful for us to trace the supply of drugs, vaccines etc. It has been helpful in the Malaria Mukta Bastar Abhiyaan by the Chattisgarh government, it has been helpful in tracing patients during COVID time, our doctors from medical

college at Raipur were able to guide doctors at the district level; we have the Mitadin Programme where the digital technology has helped bridge the payment to the Mitadins from about 1.5-2 years gap to almost every month.”

Talking about expansion of healthcare facilities especially keeping in mind COVID treatment after the second wave, he said “We started in September to put in oxygen generating plants and now the Government of India has also pitched in. 49 plants are now being made available through Defence Research and Development Organisation (DRDO), the rest 56-57 we are pitching. Earlier there was a single lab - National Institute of Virology in Pune that was able to diagnose or verify if a patient had corona. Now we have nine labs in medical colleges and six in the district hospitals, 10 out of which are functional, five will be made functional very soon as soon as we get the machinery.”

Highlighting that Chhattisgarh has been one of the leading states in India's vaccination programme which is also the world's fastest, Deo elucidating on the vaccine coverage in the state, said, “The vaccination experience for the state has been mixed, in the sense that we have vaccinated between 35-40 per cent of the targeted population with dose 1 and 2. We need to vaccinate around 4 crores in Chhattisgarh of which we have vaccinated around 1.55 crore to 1.60 crore doses. This means that about 40 percent of the population have been administered the first and second dose. We have the capacity to be able to vaccinate a minimum of three lakhs patients, even five lakh in a day which takes the state's capacity to vaccinate 1 to 1.5 crore patients every month. According to this, our job would be done in two months. But the vaccines are not available.”

The minister further stated that the state department’s affordable diagnostics scheme which will include setting up new diagnostic labs in districts to conduct blood tests free of cost will be available in districts till March 2022.

Informing about the decisions taken by the state in the healthcare sector and future plans for improving accessibility and affordability, he said “One aspect of improving the quality and delivery of healthcare will be establishing a stable IT platform. The other would be identifying each individual, unless you identify each individual of the state, you will not be able to approach or provide them health services. We are also aiming to have a medical college in each of the 11 Lok Sabha constituencies. Today we have six medical colleges running, three sanctioned and one we are taking over a private medical college.”

He added, "We are bringing in services, vision, budget and construction all together and hoping for a much better health service delivery."

<https://health.economictimes.indiatimes.com/news/industry/power-of-technology-is-transforming-the-healthcare-ecosystem-ts-singh-deo/86782822>

THE TIMES OF INDIA*Wed, 06 Oct 2021*

India-Japan maritime exercise 'JIMEX' to be conducted from October 6

New Delhi: The fifth edition of the India-Japan Maritime Bilateral Exercise (JIMEX) will be conducted in the Arabian Sea from October 6-8.

JIMEX-21 aims to develop a common understanding of operational procedures and enhance inter-operability through the conduct of a multitude of advanced exercises, across the entire spectrum of maritime operations. Multi-faceted tactical exercises involving weapon firings, cross-deck helicopter operations and complex surface, anti-submarine and air warfare drills will consolidate coordination developed by the two navies, the Ministry of Defence informed in a statement.



Japan & India bilateral maritime exercise. (File photo)

Indigenously built guided missile stealth destroyer 'Kochi' and guided-missile frigate 'Teg', under the command of Rear Admiral Ajay Kochhar, who is the flag officer commanding the western fleet will represent the Indian Navy.

The Japanese Maritime Self-Defence Force will be represented by JMSDF ships Kaga, an Izumo Class Helicopter Carrier and Murasame, a Guided Missile Destroyer, led by Rear Admiral Ikeuchi Izuru, Commander Escort Flotilla - 3 (CCF-3). In addition to ships, P8I Long Range Maritime Patrol Aircraft, Dornier Maritime Patrol Aircraft, integral helicopters and MiG 29K fighter aircraft will also participate in the exercise.

Naval cooperation between India and Japan has increased in scope and complexity over years. JIMEX-21 will further enhance the cooperation and mutual confidence between the two navies and fortify the long-standing bond of friendship between the two countries, the Defence Ministry informed.

The exercise will be conducted between the Indian Navy (IN) and the Japan Maritime Self-Defence Force (JMSDF). JIMEX series of exercises were commenced in January 2012 with a special focus on maritime security cooperation. The last edition of JIMEX was conducted in September 2020.

<https://timesofindia.indiatimes.com/india/india-japan-maritime-exercise-jimex-to-be-conducted-from-october-6/articleshow/86782602.cms>

India, SL armies conduct counter terrorism drills

New Delhi: The joint military exercise between India and Sri Lanka -- Mitra Shakti started on Thursday at the Combat Training School, in Ampara in Sri Lanka.

The exercise would be conducted from October 5 to October 15.

The Indian Army contingent comprising 120 personnel of Infantry Battalion Group and a similar strength from a Battalion of the Sri Lankan Army are participating in the bilateral exercise.

"Over the next few days, troops will train, share and rehearse tactical drills to undertake joint counter-terrorism operations in a semi urban/rural environment under United Nations mandate," the Indian Army said in a statement.

Senior military observers and dignitaries of the Indian and the Sri Lankan armies will be witnessing the validation phase of the exercise.

The exercise provides an ideal platform for both contingents to share their operational experience and expertise while also being instrumental in broadening the inter-operability and co-operation between the armies of India and Sri Lanka.

Last month, India and Nepal carried out joint military training at Pithoragarh in Uttarakhand from September 20. The exercise named as Surya Kiran was held between Indian Army and Nepali Army.

During this exercise, an Infantry Battalion from Indian Army and an equivalent strength from the Nepali Army shared their experiences gained during the conduct of various counter-insurgency operations over a prolonged period in their respective countries.

<https://www.daijiworld.com/news/newsDisplay?newsID=880400>



Wed, 06 Oct 2021

Silicon anodes muscle in on battery technology

Silicon is a staple of the digital revolution, shunting loads of signals on a device that's likely just inches from your eyes at this very moment.

Now, that same plentiful, cheap material is becoming a serious candidate for a big role in the burgeoning battery business. It's especially attractive because it's able to hold 10 times as much energy in an important part of a battery, the anode, than widely used graphite.

But not so fast. While silicon has a swell reputation among scientists, the material itself swells when it's part of a battery. It swells so much that the anode flakes and cracks, causing the battery to lose its ability to hold a charge and ultimately to fail.

Now scientists have witnessed the process for the first time, an important step toward making silicon a viable choice that could improve the cost, performance and charging speed of batteries for electric vehicles as well as cell phones, laptops, smart watches and other gadgets.

"Many people have imagined what might be happening but no one had actually demonstrated it before," said Chongmin Wang, a scientist at the Department of Energy's Pacific Northwest National Laboratory. Wang is a corresponding author of the paper recently published in *Nature Nanotechnology*.

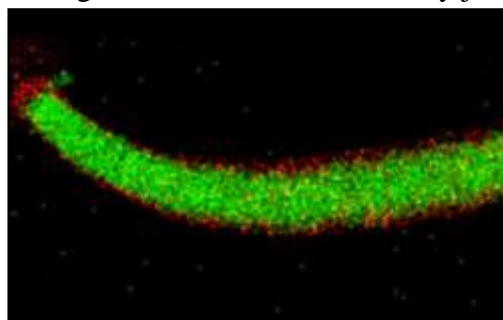
Of silicon anodes, peanut butter cups and packed airline passengers

Lithium ions are the energy currency in a lithium-ion battery, traveling back and forth between two electrodes through liquid called electrolyte. When lithium ions enter an anode made of silicon, they muscle their way into the orderly structure, pushing the silicon atoms askew, like a stout airline passenger squeezing into the middle seat on a packed flight. This "lithium squeeze" makes the anode swell to three or four times its original size.

When the lithium ions depart, things don't return to normal. Empty spaces known as vacancies remain. Displaced silicon atoms fill in many, but not all, of the vacancies, like passengers quickly taking back the empty space when the middle passenger heads for the restroom. But the lithium ions return, pushing their way in again. The process repeats as the lithium ions scoot back and forth between the anode and cathode, and the empty spaces in the silicon anode merge to form voids or gaps. These gaps translate to battery failure.

Scientists have known about the process for years, but they hadn't before witnessed precisely how it results in battery failure. Some have attributed the failure to the loss of silicon and lithium. Others have blamed the thickening of a key component known as the solid-electrolyte interphase or SEI. The SEI is a delicate structure at the edge of the anode that is an important gateway between the anode and the liquid electrolyte.

In its experiments, the team watched as the vacancies left by lithium ions in the silicon anode evolved into larger and larger gaps. Then they watched as the liquid electrolyte flowed into the gaps like tiny rivulets along a shoreline, infiltrating the silicon. This inflow allowed the SEI to



A silicon anode virtually intact after one cycle, with the silicon (green) clearly separate from a component of the solid electrolyte interphase (fluorine, in red). Credit: Chongmin Wang | Pacific Northwest National Laboratory

develop in areas within the silicon where it shouldn't be, a molecular invader in a part of the battery where it doesn't belong.

That created dead zones, destroying the ability of the silicon to store lithium and ruining the anode.

Think of a peanut butter cup in pristine shape: The chocolate outside is distinct from the soft peanut butter inside. But if you hold it in your hand too long with too tight a grip, the outer shell softens and mixes with the soft chocolate inside. You're left with a single disordered mass whose structure is changed irreversibly. You no longer have a true peanut butter cup. Likewise, after the electrolyte and the SEI infiltrate the silicon, scientists no longer have a workable anode.

The team witnessed this process begin immediately after just one battery cycle. After 36 cycles, the battery's ability to hold a charge had fallen dramatically. After 100 cycles, the anode was ruined.

Exploring the promise of silicon anodes

Scientists are working on ways to protect the silicon from the electrolyte. Several groups, including scientists at PNNL, are developing coatings designed to act as gatekeepers, allowing lithium ions to go into and out of the anode while stopping other components of the electrolyte.

Scientists from several institutions pooled their expertise to do the work. Scientists at Los Alamos National Laboratory created the silicon nanowires used in the study. PNNL scientists worked together with counterparts at Thermo Fisher Scientific to modify a cryogenic transmission electron microscope to reduce the damage from the electrons used for imaging. And Penn State University scientists developed an algorithm to simulate the molecular action between the liquid and the silicon.

Altogether, the team used electrons to make ultra-high-resolution images of the process and then reconstructed the images in 3-D, similar to how physicians create a 3-D image of a patient's limb or organ.

"This work offers a clear roadmap for developing silicon as the anode for a high-capacity battery," said Wang.

More information: Chongmin Wang et al, Progressive growth of the solid–electrolyte interphase towards the Si anode interior causes capacity fading, *Nature Nanotechnology* (2021). DOI: [10.1038/s41565-021-00947-8](https://doi.org/10.1038/s41565-021-00947-8)

Journal information: [Nature Nanotechnology](https://phys.org/news/2021-10-silicon-anodes-muscle-battery-technology.html)
<https://phys.org/news/2021-10-silicon-anodes-muscle-battery-technology.html>

Single-atom-thick semiconductor sandwich is a significant step toward ultra-low-energy electronics

A new 'sandwich-style' fabrication process placing a semiconductor only one atom thin between two mirrors has allowed Australian researchers to make a significant step towards ultra-low energy electronics based on the light-matter hybrid particles exciton-polaritons.

The study, led by the Australian National University, demonstrated robust, dissipationless propagation of an exciton mixed with light bouncing between the high-quality mirrors.

Conventional electronics relies on flowing electrons, or 'holes' (a hole is the absence of an electron, ie a positively-charged quasiparticle).

However, a major field of future electronics focusses instead on use of excitons (an electron bound to a hole) because, in principle, they could flow in a semiconductor without losing energy by forming a collective superfluid state. And excitons in novel, actively studied atomically-thin semiconductors are stable at room temperature.

Atomically-thin semiconductors are thus a promising class of materials for low-energy applications such as novel transistors and sensors. However, precisely because they are so thin, their properties, including the flow of excitons, are strongly affected by disorder or imperfections, which can be introduced during fabrication.

The ANU-led FLEET team—with colleagues at Swinburne University and FLEET Partner institution Wroclaw University—has coupled the excitons in an atomically-thin material to light to demonstrate for the first time their long-range propagation without any dissipation of energy, at room temperature. When an exciton (matter) binds with a photon (light), it forms a new hybrid particle—an exciton-polariton. Trapping light between two parallel high-quality mirrors in an optical microcavity allows this to happen.

In the new study, a new 'sandwich-style' fabrication process for the optical microcavity allowed the researchers to minimize damage to the atomically-thin semiconductor and to maximize the interaction between the excitons and the photons. The exciton-polaritons formed in this structure were able to propagate without energy dissipation across tens of micrometers, the typical scale of an electronic microchip.

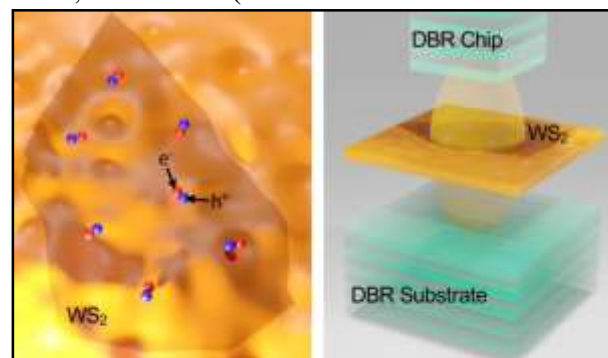
Microcavity construction is the key

A high-quality optical microcavity that ensures the longevity of light (photonic) component of exciton-polaritons is the key to these observations.

The study found that exciton-polaritons can be made remarkably stable if the microcavity is constructed in a particular way, avoiding damage of the fragile semiconductor sandwiched between the mirrors during fabrication.

"The choice of the atomically-thin material in which the excitons travel is far less important," says lead and corresponding author Matthias Wurdack.

"We found that construction of that microcavity was the key," says Matthias, "And while we used tungsten sulfide (WS₂) in this particular experiment, we believe any other atomically-thin TMDC material would also work."



Left: Electron-hole pairs in atomically-thin WS₂ on a substrate where dielectric disorder is similar size to excitons. Right: Hybridisation of excitons and photons leads to formation of polaritons in an all-dielectric high-Q optical microcavity, reducing effect of dielectric disorder. Credit: FLEET

(Transition metal dichalcogenides are excellent hosts for excitons, hosting excitons that are stable at room temperature and interact strongly with light).

The team built the microcavity by stacking all its components one by one. First, a bottom mirror of the microcavity is fabricated, then a semiconductor layer is placed onto it, and then the microcavity is completed by placing another mirror on top. Critically, the team did not deposit the upper mirror structure directly onto the notoriously fragile atomically-thin semiconductor, which is easily damaged during any material deposition process.

"Instead, we fabricate the entire top structure separately, and then place it on top of the semiconductor mechanically, like making a sandwich," says Matthias.

"Thus we avoid any damage to the atomically-thin semiconductor, and preserve the properties of its excitons." Importantly, the researchers optimized this sandwiching method to make the cavity very short, which maximized the exciton-photon interaction.

"We also benefitted from a bit of serendipity," say Matthias. "An accident of fabrication that ended up being key to our success!"

The serendipitous 'accident' came in the form of an air gap between the two mirrors, making them not strictly parallel. This wedge in the microcavity creates a voltage/potential 'slope' for the exciton-polaritons, with the particles moving either up or down the incline.

The researchers discovered that a proportion of exciton-polaritons travel with conservation of total (potential and kinetic) energy, both up and down the incline. Traveling down the slope, they convert their potential energy into equal amount of kinetic energy, and vice versa.

That perfect conservation of total energy means no energy is being lost in heat (due to 'friction'), which signals 'ballistic' or dissipationless transport for polaritons. Even though the polaritons in this study do not form a superfluid, the absence of dissipation is achieved because all scattering processes that lead to energy loss are suppressed.

"This demonstration, for the first time, of ballistic transport of room-temperature polaritons in atomically-thin TMDCs is a significant step towards future, ultra-low energy exciton-based electronics," says group leader Prof Elena Ostrovskaya (ANU).

Apart from creating the potential "slope," that same fabrication accident created a potential well for exciton-polaritons. This enabled the researchers to catch and accumulate the traveling exciton-polaritons in the well—an essential first step for trapping and guiding them on a microchip."

Long-range, room-temperature flow of exciton-polaritons

Furthermore, the researchers confirmed that exciton-polaritons can propagate in the atomically-thin semiconductor for tens of micrometers (easily far enough for functional electronics), without scattering on material defects. This is in contrast to excitons in these materials, the travel length of which is dramatically reduced by these defects. Moreover, the exciton-polaritons were able to preserve their intrinsic coherence (correlation between signal at different points in space and time), which bodes well for their potential as information carriers. "This long-range, coherent transport was achieved at room temperature, which is important for development of practical applications of atomically-thin semiconductors" said Matthias Wurdack.

If future excitonic devices are to be a viable, low-energy alternative to conventional electronic devices, they must be able to operate at room temperature, without the need for energy-intensive cooling. "In fact, counterintuitively, our calculations show that the propagation length is getting longer at higher temperatures, which is important for technological applications," said Matthias.

"Motional narrowing, ballistic transport, and trapping of room-temperature exciton polaritons in an atomically-thin semiconductor" was published in *Nature Communications* in September 2021.

More information: M. Wurdack et al, Motional narrowing, ballistic transport, and trapping of room-temperature exciton polaritons in an atomically-thin semiconductor, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-25656-7](https://doi.org/10.1038/s41467-021-25656-7)

Journal information: [*Nature Communications*](#)

<https://phys.org/news/2021-10-single-atom-thick-semiconductor-sandwich-significant-ultra-low-energy.html>

Trapping light with disorder

Like a pinball game in the hands of a good player, a collection of obstacles randomly positioned can be sufficient to trap light without the need for an optical cavity. By adding amplification, at no cost, a mirrorless laser—often dubbed "random laser"—can be obtained.

Using this concept researchers at Bar-Ilan University in Israel have demonstrated disorder-induced localization, a rather difficult wave phenomenon to observe, but also one of the most striking and puzzling manifestations of wave interference predicted by Nobel Prize laureate P.W. Anderson for electrons and, later, generalized to light waves. This phenomenon was recently elucidated in the journal *Optica*.



Credit: CC0 Public Domain

"We realized that a random laser has many degrees of freedom that are not available in conventional cavity lasers. Based on this discovery, we showed that laser emission can be simply controlled by shaping the pump profile that provides the gain inside the scattering medium," says Prof. Patrick Sebbah, of the Department of Physics and Institute of Nanotechnology and Advanced Materials at Bar-Ilan University, who led the research. "This is done optically with total flexibility. It contrasts with the technical challenge of realigning a mirror cavity in a conventional laser," adds Sebbah, whose research collaborators included Prof. Mélanie Lebental, from France, and students from his Mesoscopic Optics group at Bar-Ilan.

Because this faint phenomenon is amplified in a "plastic microlaser", it is possible to directly observe laser light built up in a confined scattering region, each confined mode corresponding to a different color/wavelength emission. All of these colors/modes lase together and localized modes interact, each one trying to seize to gain for itself at the expense of the others.

In order to observe these localized lasing modes individually, Sebbah and colleagues proposed a method, based on a 2014 article in *Nature Physics*, to disentangle interacting modes and suppress mutual competition for gain. To do so, a non-uniform gain distribution is created that optimally selects one mode and extinguishes the other.

They were surprised to find that once mode competition was suppressed and a laser mode optimized, they were able to boost laser power-efficiency, and unleash the "optimally-outcoupled lasing modes" i.e., the laser modes with the strongest emission for the smallest energy cost. "This is the magic of modal confinement by multiple scattering of light," says Bhupesh Kumar, the postdoc who led the experiments.

These findings open a unique route to investigate Anderson localization, one of the most challenging tasks in optics, to explore the role of nonlinearities on localization and test experimentally theoretical predictions. The method developed here can be applied to the design of highly efficient and stable random microlasers, where the random and non-Hermitian nature of these lasers offers unprecedented degrees of freedom.

ore information: Patrick Sebbah et al, Localized modes revealed in random lasers, *Optica* (2021). [DOI: 10.1364/OPTICA.428217](https://doi.org/10.1364/OPTICA.428217)

Journal information: [Optica](#), [Nature Physics](#)
<https://phys.org/news/2021-10-disorder.html>



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Convalescent plasma 'futile' in treating severe COVID-19 cases: research

By Monique Beals

Scientists from the University of Pittsburgh found that convalescent plasma treatment is "futile" to treat critically ill COVID-19 patients, according to findings from a study published Monday in the Journal of the American Medical Association.

Convalescent plasma treatment involves taking blood containing antibodies from recovered COVID-19 patients and infusing it into people who are currently fighting the virus.

The antibodies were thought to have some ability to help with the recovery process for active infections. Though the treatment style was successful for Ebola, it was deemed ineffective for most critically ill patients with COVID-19, according to the Pittsburgh Post-Gazette.



"Despite other trial results, there's still been a lot of interest in using this treatment for COVID-19 patients in the hospital," the University of Pittsburgh's Bryan McVerry, who was a co-lead author for the study, said to the Post-Gazette.

"I think that the evidence we provide in this study should put to rest the question of whether there's any benefit from this intervention in hospitalized patients," he added.

The study found that the treatment resulted in "a low likelihood of providing improvement" for severe COVID-19 patients who participated in the trial, but the research did not conclude why it was ineffective.

"We speculate that it could be a combination of too few high-quality antibodies in the plasma and these patients being too far along in their illness with a runaway inflammatory immune response for those antibodies to turn the tide," Derek Angus, a senior author for the study, told the Post-Gazette.

Despite the treatment's lack of success, McVerry added that the "prevention of hospitalization is the number one treatment for COVID-19, and that prevention comes in the form of vaccination," the Post-Gazette reported.

<https://thehill.com/policy/healthcare/575445-convalescent-plasma-futile-in-treating-severe-covid-19-cases-research>

