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# समाचार पत्रों से चयित अंश Newspapers Clippings

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

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**Press Information Bureau**  
**Government of India**

**Ministry of Defence**

*Thu, 31 Dec 2020 8:34PM*

### **BEL signs contract with Indian Navy for initial supply of indigenously developed Laser Dazzlers**

Bharat Electronics Limited (BEL) has signed a contract with Indian Navy for initially supply 20 Light Amplification by Stimulated Emission of Radiation Dazzlers (Laser Dazzlers) in New Delhi today. The BEL had earlier this month won the contract beating global Original Equipment Manufacturers (OEMs) in buy global category. These would be manufactured by BEL, Pune plant.

The Laser Dazzler is used as a non-lethal method for warning and stopping suspicious vehicles/boats/aircrafts/UAVs/pirates etc. from approaching secured areas during both day and night. It is capable of dazzle and thereby suppress the person's/optical sensor's action with disability glare in case of non-compliance to orders. It disorient/ confuse/blind a person temporarily. It also dazzles and distract aircraft/UAVs. It is a portable, shoulder operated and ruggedized for military use in adverse environmental conditions. Laser dazzler technology was developed by Defence Research and Development Organisation (DRDO).

This unique product is indigenously designed and developed for first time for the Armed Forces. It will support the 'Atmanirbhar Bharat' initiative of Prime Minister Shri Narendra Modi.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1685201>

## **Outlook**

*Fri, 01 Jan 2021*

### **BEL signs contract with Indian Navy to supply laser dazzlers**

New Delhi: The Bharat Electronics Limited signed a contract with the Indian Navy on Thursday to supply 20 laser dazzlers, a non-lethal weapon for warning and stopping suspicious vehicles, boats and aircraft.

The Defence Ministry in a statement said that this weapon has been indigenously designed and developed for the first time, and it also "dazzles and distracts aircraft/UAVs (Unmanned Aerial Vehicles)".

It stated that the Bharat Electronics Limited (BEL) had earlier in December won the contract to supply the laser dazzlers to the Indian Navy.

"It (laser dazzlers) is capable of dazzle and thereby, suppress the person's/optical sensor's action with disability glare in case of non-compliance to orders. It disorients/ confuses/blinds a person

temporarily. It also dazzles and distracts aircraft/UAVs (unmanned aerial vehicles)," the statement said.

These weapons would be manufactured in the BEL's plant in Pune.

"The BEL has signed a contract with the Indian Navy for initially supplying 20 Light Amplification by Stimulated Emission of Radiation Dazzlers (laser dazzlers) in New Delhi today," the statement said.

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

*Source: PTI*

<https://www.outlookindia.com/newscroll/bel-signs-contract-with-indian-navy-to-supply-laser-dazzlers/2002566>



Fri, 01 Jan 2021

## DRDO hands over indigenous highly mobile bridges to Indian Army, makes SAHAYAK-NG for Navy

*The bridges which have been developed by the Research and Development Establishment (Engineers) under DRDO and is part of Armament and Combat Engineering technology cluster, which is the Pune-headquartered*

The year ends with the Defence Research and Development Organisation (DRDO) handing over highly mobile bridges to the Indian Army. The bridges which have been developed by the Research and Development Establishment (Engineers) under DRDO and is part of Armament and Combat Engineering technology cluster, which is the Pune-headquartered.

### What is so special about the bridges?

These will help in fulfilling the requirement of mobility to the Indian armed forces and will bridge the gaps during operations.

These are 10-meter short-span mechanically launched bridges and the first three were handed over to the Indian Army earlier this week at the facility of Larsen & Toubro Ltd at Talegaon in Pune, where these are being manufactured.

These bridges have been developed based on the requirement of the armed forces and are being done in coordination with the Corps of Engineers, Indian Army.

Also, the DRDO has developed different variants of the bridges — five-meter and 15 meters. And these have been inducted in the Indian Army.

According to a statement from the Ministry of Defence (MoD) "It is a step towards weaning away of our armed forces from foreign manufactured equipment. These have been designed and developed indigenously and are being delivered as per the schedule."

This belongs to the Military Load Classification — 70 load class. It is capable of bridging smaller caps and canals up to 10 meters in length.

It has a high mobility launching platform which is suitable for heavy military traffic.

There is a double-A shaped trestle that provides heavy military vehicles stability.



**These bridges have been developed based on the requirement of the armed forces and are being done in coordination with the Corps of Engineers, Indian Army. (Photo source: IE)**

These can be used for quick construction which requires minimum crew and lighting arrangement for deployment at night.

DRDO has also successfully conducted the maiden Flight Trial of SAHAYAK-NG, Air Droppable Container

Along with the Indian Navy, DRDO on Thursday has successfully conducted the test trial of 'SAHAYAK-NG'.

It is India first indigenously designed and developed Air Dropped Container. It was dropped from IL 38SD aircraft (Indian Navy) off the coast of Goa.

#### **The purpose of the test?**

To further enhance Indian Navy's operational logistics capabilities and to also provide critical engineering stores to ships.

For collecting spares and stores, the ships which are deployed more than 2000 km from the coast, may not have to come close to the coast any more.

#### **Which DRDO labs are involved?**

There are two labs — NSTL, Visakhapatnam and ADRDE, Agra.

These two labs developed SAHAYAK-NG container along with the industry partner M/s Avantel for GPS integration and can carry a payload up to 50 kg and can be dropped from a heavy aircraft.

<https://www.financialexpress.com/defence/drdo-hands-over-indigenous-highly-mobile-bridges-to-indian-army-makes-sahayak-ng-for-navy/2161634/>

## **Business Standard**

*Fri, 01 Jan 2021*

### **Bharat Dynamics gains after cabinet Oks Akash missile exports**

Bharat Dynamics rose 1.53% to Rs 344.30 after the company said that it is geared up to take up export orders for Akash Missile.

With the announcement from the Union Cabinet regarding clearance of Akash Weapon System for export, Bharat Dynamics (BDL), the manufacturer of Akash Missile, is geared up to take up export order.

Given the export potential and demand of Akash in the international market, BDL has been promoting the product at various forums including national and international exhibitions. The missile being offered for exports will be of a different version. BDL is already supplying Torpedoes to a foreign country, it added.

The Akash Weapon System, designed and developed by DRDO with 96% indigenous content, is being manufactured by BDL at its Hyderabad Unit with a large number of supply chain partners which include DPSUs, MSMEs and private industry.

BDL manufactured Akash Missiles are already in the inventory of the Indian Army as well as Indian Air Force and the successful test firing results reaffirm the Company's commitment to achieve the highest quality standards about product and support to its customers.

Commodore Siddharth Mishra (Retd), CMD, BDL, stated: "The company has received export leads for the Akash Weapon System. Now, with the export clearance accorded by the Government of India, BDL is set to expand its customer base in the international market. The company is confident of meeting the export demand in addition to meeting requirements of the Indian Armed Forces, as BDL has adequate established production facilities."

Bharat Dynamics manufactures defense equipment. The company offers ammunitions, counter measures dispensing, infra red interference indicators, and missile systems. It serves military and aerospace industries in India. As of 30 September 2020, the Government of India held 74.93% stake in the company.

The company's standalone net profit tanked 75.3% to Rs 26.25 crore on 62.6% slump in net sales to Rs 240.03 crore in Q2 September 2020 over Q2 September 2019.

*(This story has not been edited by Business Standard staff and is auto-generated from a syndicated feed.)*

[https://www.business-standard.com/article/news-cm/bharat-dynamics-gains-after-cabinet-oks-akash-missile-exports-121010100198\\_1.html](https://www.business-standard.com/article/news-cm/bharat-dynamics-gains-after-cabinet-oks-akash-missile-exports-121010100198_1.html)

## Defence News

## Defence Strategic: National/International

# Business Standard

Fri, 01 Jan 2021

## Indian Air Force Chief Bhadauria launches e-governance portal

*Air Chief Marshal RKS Bhadauria launched an e-governance portal for the Indian Air Force (IAF) on Thursday in order to promote a paperless office*

New Delhi: Air Chief Marshal RKS Bhadauria launched an e-governance portal for the Indian Air Force (IAF) on Thursday in order to promote a paperless office, an official statement said.

The launch of e-governance in IAF marks a paradigm shift from the current method of correspondence, filing and documentation to a digital one, the statement said.

"The implementation undertaken as part of Digital India and e-governance initiative will transform the entire Indian Air Force to a 'paperless office' workflow," it said.

"The platform would achieve enhanced transparency, improved efficiency, increased accountability, assured data integrity and rapidly accessible archives along with a major reduction in the use of paper," it added.

Bhadauria launched the portal at Vayu Bhawan here.

This project started in April and was to be completed by January 1, 2021, the statement said.

The e-governance or e-office application has been designed indigenously from scratch and customised to meet the filing system requirements of the IAF, it said.

*(Only the headline and picture of this report may have been reworked by the Business Standard staff; the rest of the content is auto-generated from a syndicated feed.)*

[https://www.business-standard.com/article/current-affairs/indian-air-force-chief-bhadauria-launches-e-governance-portal-120123101042\\_1.html](https://www.business-standard.com/article/current-affairs/indian-air-force-chief-bhadauria-launches-e-governance-portal-120123101042_1.html)



Indian Air Force (IAF) chief Rakesh Kumar Singh Bhadauria (File)

## Indian Army Chief MM Naravane receives guard of honour during South Korea visit

*Indian Army Gen. MM Naravane is visiting S. Korea, where he will meet top military & political leadership to discuss ways to enhance bilateral cooperation*

*By Vishal Tiwari*

Indian Army Chief General MM Naravane is on a 3-day visit to South Korea, where he will meet top military & political leadership to discuss ways to enhance bilateral cooperation between India & ROC.

Gen. Naravane received a Guard of Honour at Republic of Korea Army Headquarters in Gyeryong, South Korea. He called on Gen. Nam Yeong to discuss issues of bilateral defence cooperation.

The Chief of Army Staff visited the national cemetery to pay tribute to the brave hearts who laid their lives during the Korean civil war, which led to the creation of North and South Korea.

COAS also visited the War Memorial in Seoul to remember the contributions of the Indian Army during the Korean War, where 60 Para Field Ambulance provided much-needed humanitarian assistance.

Army Chief Naravane visited the Demilitarized Zone (DMZ) near the border with North Korea and the 30th Armoured Brigade.

South Korea is one of the largest suppliers of military equipment to India. Gen. Naravane also evaluated some of the latest military equipment while in Seoul.

Gen. Naravane held a meeting with the top brass of the military leadership of South Korea. The two sides discussed avenues for enhancing India-Republic of Korea defence relations.

<https://www.republicworld.com/india-news/general-news/in-pics-indian-army-chief-mm-naravane-receives-guard-of-honour-during-south-korea-visit-imageid-8.html>



## The Shillong Times

ESTABLISHED 1945

## Indian Navy chief reviews security situation at forward operating base in Gujarat

New Delhi: Indian Navy chief, Admiral Karambir Singh visited INS Dwarka, Indian Navy's forward operating base at Gujarat's Okha, on New Year's Eve on Thursday and reviewed operations and security aspects of the region.

Admiral Singh was briefed by the Flag Officer Commanding Gujarat, Daman and Diu on maritime operations and security aspects relevant to the naval command area, which is a crucial strategic position as far as the navy is concerned due to its proximity to Pakistan.

"He also took stock of coastal surveillance initiatives by Gujarat, Daman and Diu Area and interacted with personnel from Naval Station Okha and other units," Indian Navy said



in a statement.

Appreciating the quality work put in by the station, he encouraged the personnel to keep up the good work as INS Dwarka enters its Golden Jubilee year.

He also wished all personnel and families the very best for the New Year.

Last month, Admiral Singh visited the Andaman and Nicobar Command, the country's first joint theatre command and met personnel stationed at INS Baaz.

INS Baaz, a Naval Air Station located at Campbell Bay on the Greater Nicobar Island, is among the most significant bases of the country's military owing to its location near the Malacca Straits.

The geo-strategically located base overlooks critical International Sea Lanes passing through the Indian Ocean Region.

<https://theshillongtimes.com/2020/12/31/indian-navy-chief-reviews-security-situation-at-forward-operating-base-in-gujarat/>



**Press Information Bureau**

**Government of India**

**Ministry of Defence**

*Thu, 31 Dec 2020 6:08PM*

## **Chief of the Naval Staff (CNS) visits Gujarat Daman and Diu Naval area**

Admiral Karambir Singh, the Chief of the Naval Staff (CNS) visited INS Dwarka, Indian Navy's forward operating base at Okha, Gujarat, on New Year's Eve.

The CNS was briefed by the Flag Officer Commanding Gujarat, Daman and Diu on maritime operations and security aspects relevant to Gujarat, Daman & Diu (GD&D) Naval Area. He also took stock of coastal surveillance initiatives by GD&D Area and interacted with personnel from Naval Station Okha and other units.

Appreciating the quality work put in by the station, he encouraged the personnel to keep up the good work as INS Dwarka enters its Golden Jubilee year. The CNS also wished all personnel and families at GD&D Area the very best for the New Year.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1685125>







**Press Information Bureau  
Government of India**

**Ministry of Defence**

*Thu, 31 Dec 2020 8:36PM*

## **MoD signs contract with BEL to supply indigenously developed 10 Lynx U2 Fire Control systems for Indian Navy**

Ministry of Defence (MoD) has signed a contract with Bharat Electronics Limited (BEL) for procurement of 10 Lynx U2 Fire Control systems for frontline warships of Indian Navy at a cost of Rs 1,355 crore under Buy (Indian) category in New Delhi today. The Lynx system has been designed and developed indigenously that would further the 'Atmanirbhar Bharat' vision of Prime Minister Shri Narendra Modi.

The LYNX U2 GFCS is a Naval Gun Fire Control System designed to acquire, track and engage targets amidst sea clutter. It is capable of accurately tracking air/surface targets, generating required target data for predicting weapon aiming points and engaging target. The target engagement is carried out with the medium/short range gun mounts like Russian AK176, A190 and AK630 and the SRGM available onboard ships.

The Gun Fire Control System has been designed with an open and scalable architecture permitting simple and flexible implementation in many different configurations. The system has been developed and delivered to Indian Navy and has been in service for over two decades, satisfactorily meeting the tactical requirements of Indian Naval ships of various classes like destroyers, frigates, missile boats, corvettes, etc.

The system has been upgraded continuously and indigenisation has been the major focus along with technology upgrades. The indigenous content of the system has been continuously increased, generation to generation to eliminate the dependency on foreign OEMs. The system will be installed on the NOPV, Talwar and Teg class of ships. The system including the Tracking Radar, Servo and Weapon Control Modules has been completely designed and developed by BEL. The indigenous system will ensure maximum up-time of the system and guarantees excellent Product support throughout its life time.

The system proposed in the contract is of the fourth generation and is a completely indigenised system, developed in the true spirit of 'Atmanirbhar Bharat'. These will be delivered by BEL, Bengaluru over the next five years.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1685205>

## **GSL inks contract with Army for specialised patrol boats**

Panaji: Goa Shipyard Limited (GSL) on Thursday signed a contract to build 12 high-performance specialised patrol crafts for the Indian Army which will be utilised along the disputed waters at the Line of Actual Control, particularly Pangong Tso. The specialised boats will be delivered to the Indian Army by December 2021, said GSL officials.

While GSL has built warships and patrol vessels for the Indian Navy and the Indian Coast Guard, construction of highperformance patrol vessels which are capable of performing at high altitudes will add to the defence public sector undertaking's diverse capabilities.

Though GSL had earlier built over 170 glass-reinforced plastic (GRP) boats for the Union ministry of Home Affairs, the 12 boats for the Indian Army will be based on a new design and fitted with specialised equipment to operate in the harsh conditions up north of the country.

"These are composite hull boats and will have advanced sensor systems to help the Army fulfil its role," said chairman and managing director B B Nagpal who was in New Delhi to ink the contract with the Indian Army.

GSL bagged the contract after emerging as the lowest bidder for the tender where public and private ship builders also participated. With skirmishes between Indian and Chinese soldiers increasing along the LAC which passes over water bodies and mountains, the Indian Army floated the tender to procure 12 specialised boats. "These craft will be among only few crafts in the world for such specialized operations," GSL stated.

<https://timesofindia.indiatimes.com/city/goa/gsl-inks-contract-with-army-for-specialised-patrol-boats/articleshow/80053321.cms>

## **China violates border agreements with India, swears by 2003 pact on Tibet | Analysis**

*The Chinese embassy official not just cherry-picked bilateral agreements with India, but also portions from the 2003 pact that the embassy decided to quote*

*By Shishir Gupta*

New Delhi: Wednesday's gratuitous advice by a press official of the Chinese embassy that asked the Indian media to stay away from the Tibet issue lest it further damages the bilateral relations is not surprising.

Just two days before the Galwan flare-up on June 15, another junior official posted in Chinese embassy in Pakistan tweeted an article written by a Chinese expert linking the Ladakh stand-off to so-called Indian moves to abrogate Article 370 and bifurcate the erstwhile state of Jammu and Kashmir into two union territories. The author, a deputy director in a think-tank linked to the Chinese intelligence, virtually endorsed Pakistan's position on Kashmir and Article 370, by calling the Indian move "unilateral."

To their credit, Chinese embassy officials have no qualms in contradicting either the Indian media or the Indian government by ferociously defending political positions of Beijing, be it Tibet, Xinjiang, Kashmir, Arunachal Pradesh or Ladakh. It was not so long ago that a Chinese diplomat

publicly contradicted the then defence minister of India Pranab Mukherjee on the 1962 war at a Mumbai conference.

In her statement on Wednesday, the Chinese Embassy official has quoted a 2003 bilateral document to remind Indian media that New Delhi had recognised the Tibet Autonomous Region as part of Chinese territory and decided not to allow Tibetans to engage in political activities against China. The quoted document is “Declaration on Principles for Relations and Comprehensive Cooperation between the Republic of India and the People’s Republic of China” signed on June 23, 2003.

What the official missed was that just two paragraphs before the bilateral commitment on Tibet, the 2003 document refers to the boundary question. It said: The two agreed that pending an ultimate solution, they should work together to maintain peace and tranquility in the border areas, reiterated their commitment to continue implementation of the agreements for this purpose, including clarification of the Line of Actual Control (LAC).” The pacts referred to in the text are the 1993 and 1996 agreements to maintain peace and tranquility and not unilaterally change the status of the LAC.



**China’s People’s Liberation Army has violated all the agreements to maintain peace and tranquillity along the Line of Actual Control(AP File Photo)**

The official had not just cherry-picked agreements, but also portions from the pact that she decided to quote. Because, as India has said on several occasions, the actions of China’s People’s Liberation Army in the East Ladakh sector starting from April-May this year have violated every agreement and commitment on border peace that the two countries have signed.

This unilateral action has led to a military stand-off between the world’s largest, and second-largest army. Beijing has already admitted that it wants to impose the 1959 line on the 1597-kilometre long Ladakh border. This means that China will hold its ground on McMahon Line in Arunachal Pradesh.

Apart from lecturing the Indian media on Tibet, the Chinese narrative spread through its social media influencers is that the Indian government has been taught a lesson in Ladakh for tilting towards the US in the context of Indo-Pacific and the QUAD security dialogue. Clearly Beijing wants India to be part of the group of south-east Asian countries that have fallen in line and come close to becoming a tributary state to the Middle Kingdom, which is rapidly trying to move towards its ambition to be centre of the globe.

The fact is that since the establishment of PRC on October 1, 1949, the Chinese positions have been etched in stone vis-a-vis India and Beijing has not moved an inch to accommodate the Indian concerns. It expects India to be neutral, while Beijing runs roughshod over New Delhi in South Asia and beyond. The present communist regime wants India to continue with economic ties with China as usual even as it tries to push back the Indian Army along the LAC. Honouring written commitments is not a one-way street as the same 2003 document talks says “neither side shall use or threaten to use force against each other.”

While a section of the Indian establishment is in favour of an early resolution of the Ladakh stand-off with even the Germany-led European Union recognising the rise of China, Beijing clearly wants a leg up on the LAC as this will be showcased as an achievement in the 2021 report card of the 100 years of Chinese Communist Party rule. Any Indian eagerness towards unjust resolution will be only interpreted as a sign of weakness in Beijing.

<https://www.hindustantimes.com/analysis/in-china-s-advice-to-india-on-tibet-a-proclivity-to-cherry-pick-agreements-analysis/story-ivWZZOxt7OWe5YNsFcy1aL.html>



Fri, 01 Jan 2021

## Controlling the nanoscale structure of membranes is key for clean water, researchers find

A desalination membrane acts as a filter for salty water: push the water through the membrane, get clean water suitable for agriculture, energy production and even drinking. The process seems simple enough, but it contains complex intricacies that have baffled scientists for decades—until now.

Researchers from Penn State, The University of Texas at Austin, Iowa State University, Dow Chemical Company and DuPont Water Solutions published a key finding in understanding how membranes actually filter minerals from water, online today (Dec. 31) in *Science*. The article will be featured on the print edition's cover, to be issued tomorrow (Jan. 1).



Credit: Pixabay/CC0 Public Domain

"Despite their use for many years, there is much we don't know about how water filtration membranes work," said Enrique Gomez, professor of chemical engineering and materials science and engineering at Penn State, who led the research. "We found that how you control the density distribution of the membrane itself at the nanoscale is really important for water-production performance."

Co-led by Manish Kumar, associate professor in the Department of Civil, Architectural and Environmental Engineering at UT Austin, the team used multimodal electron microscopy, which combines the atomic-scale detailed imaging with techniques that reveal chemical composition, to determine that desalination membranes are inconsistent in density and mass. The researchers mapped the density variations in polymer film in three dimensions with a spatial resolution of approximately one nanometer—that's less than half the diameter of a DNA strand. According to Gomez, this technological advancement was key in understanding the role of density in membranes.

"You can see how some places are more or less dense in a coffee filter just by your eye," Gomez said. "In filtration membranes, it looks even, but it's not at the nanoscale, and how you control that mass distribution is really important for water-filtration performance."

This was a surprise, Gomez and Kumar said, as it was previously thought that the thicker the membrane, the less water production. Filmtec, now a part of DuPont Water Solutions, which makes numerous desalination products, partnered with the researchers and funded the project because their in-house scientists found that thicker membranes were actually proving to be more permeable.

The researchers found that the thickness does not matter as much as avoiding highly dense nanoscale regions, or "dead zones." In a sense, a more consistent density throughout the membrane is more important than thickness for maximizing water production, according to Gomez.

This understanding could increase membrane efficiency by 30% to 40%, according to the researchers, resulting in more water filtered with less energy—a potential cost-saving update to current desalination processes.

"Reverse osmosis membranes are so widely used for cleaning water, but there's still a lot we don't know about them," Kumar said. "We couldn't really say how water moves through them, so all the improvements over the last 40 years have essentially been done in the dark."

Reverse osmosis membranes work by applying pressure on one side. The minerals stay there, while the water passes through. While more efficient than non-membrane desalination processes, this still takes an immense amount of energy, the researchers said, but improving the efficiency of the membranes could reduce that burden.

"Freshwater management is becoming a crucial challenge throughout the world," Gomez said. "Shortages, droughts—with increasing severe weather patterns, it is expected this problem will become even more significant. It's critically important to have clean water available, especially in low resource areas."

The team continues to study the structure of the membranes, as well as the chemical reactions involved in the desalination process. They are also examining how to develop the best membranes for specific materials, such as sustainable yet tough membranes that can prevent the formation of bacterial growth.

"We're continuing to push our techniques with more high-performance materials with the goal of elucidating the crucial factors of efficient filtration," Gomez said.

**More information:** noscale control of internal inhomogeneity enhances water transport in desalination membranes, *Science* (2020). DOI: [10.1126/science.abb8518](https://doi.org/10.1126/science.abb8518)

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

<https://phys.org/news/2020-12-nanoscale-membranes-key.html>



*Fri, 01 Jan 2021*

## Stretching diamond for next-generation microelectronics

Diamond is the hardest material in nature. But out of many expectations, it also has great potential as an excellent electronic material. A joint research team led by City University of Hong Kong (CityU) has demonstrated for the first time the large, uniform tensile elastic straining of microfabricated diamond arrays through the nanomechanical approach. Their findings have shown the potential of strained diamonds as prime candidates for advanced functional devices in microelectronics, photonics, and quantum information technologies.

The research was co-led by Dr. Lu Yang, Associate Professor in the Department of Mechanical Engineering (MNE) at CityU and researchers from Massachusetts Institute of Technology (MIT) and Harbin Institute of Technology (HIT). Their findings have been recently published in the prestigious scientific journal *Science*, titled "Achieving large uniform tensile elasticity in microfabricated diamond".



Stretching of microfabricated diamonds pave ways for applications in next-generation microelectronics. Credit: Dang Chaoqun / City University of Hong Kong

"This is the first time showing the extremely large, uniform elasticity of diamond by tensile experiments. Our findings demonstrate the possibility of developing electronic devices through 'deep elastic strain engineering' of microfabricated diamond structures," said Dr. Lu.

## **Diamond: "Mount Everest" of electronic materials**

Well known for its hardness, industrial applications of diamonds are usually cutting, drilling, or grinding. But diamond is also considered as a high-performance electronic and photonic material due to its ultra-high thermal conductivity, exceptional electric charge carrier mobility, high breakdown strength and ultra-wide bandgap. Bandgap is a key property in semi-conductor, and wide bandgap allows operation of high-power or high-frequency devices. "That's why diamond can be considered as 'Mount Everest' of electronic materials, possessing all these excellent properties," Dr. Lu said.

However, the large bandgap and tight crystal structure of diamond make it difficult to "dope", a common way to modulate the semi-conductors' electronic properties during production, hence hampering the diamond's industrial application in electronic and optoelectronic devices. A potential alternative is by "strain engineering", that is to apply very large lattice strain, to change the electronic band structure and associated functional properties. But it was considered as "impossible" for diamond due to its extremely high hardness.

Then in 2018, Dr. Lu and his collaborators discovered that, surprisingly, nanoscale diamond can be elastically bent with unexpected large local strain. This discovery suggests the change of physical properties in diamond through elastic strain engineering can be possible. Based on this, the latest study showed how this phenomenon can be utilized for developing functional diamond devices.

### **Uniform tensile straining across the sample**

The team firstly microfabricated single-crystalline diamond samples from a solid diamond single crystals. The samples were in bridge-like shape—about one micrometre long and 300 nanometres wide, with both ends wider for gripping (See image: Tensile straining of diamond bridges). The diamond bridges were then uniaxially stretched in a well-controlled manner within an electron microscope. Under cycles of continuous and controllable loading-unloading of quantitative tensile tests, the diamond bridges demonstrated a highly uniform, large elastic deformation of about 7.5% strain across the whole gauge section of the specimen, rather than deforming at a localized area in bending. And they recovered their original shape after unloading.

By further optimizing the sample geometry using the American Society for Testing and Materials (ASTM) standard, they achieved a maximum uniform tensile strain of up to 9.7%, which even surpassed the maximum local value in the 2018 study, and was close to the theoretical elastic limit of diamond. More importantly, to demonstrate the strained diamond device concept, the team also realized elastic straining of microfabricated diamond arrays.

### **Tuning the bandgap by elastic strains**

The team then performed density functional theory (DFT) calculations to estimate the impact of elastic straining from 0 to 12% on the diamond's electronic properties. The simulation results indicated that the bandgap of diamond generally decreased as the tensile strain increased, with the largest bandgap reduction rate down from about 5 eV to 3 eV at around 9% strain along a specific crystalline orientation. The team performed an electron energy-loss spectroscopy analysis on a pre-strained diamond sample and verified this bandgap decreasing trend.

Their calculation results also showed that, interestingly, the bandgap could change from indirect to direct with the tensile strains larger than 9% along another crystalline orientation. Direct bandgap in semi-conductor means an electron can directly emit a photon, allowing many optoelectronic applications with higher efficiency.

These findings are an early step in achieving deep elastic strain engineering of microfabricated diamonds. By nanomechanical approach, the team demonstrated that the diamond's band structure can be changed, and more importantly, these changes can be continuous and reversible, allowing different applications, from micro/nanoelectromechanical systems (MEMS/NEMS), strain-engineered transistors, to novel optoelectronic and quantum technologies. "I believe a new era for diamond is ahead of us," said Dr. Lu.

**More information:** Achieving large uniform tensile elasticity in microfabricated diamond, *Science* (2020). DOI: [10.1126/science.abc4174](https://doi.org/10.1126/science.abc4174)

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

<https://phys.org/news/2020-12-diamond-next-generation-microelectronics.html>



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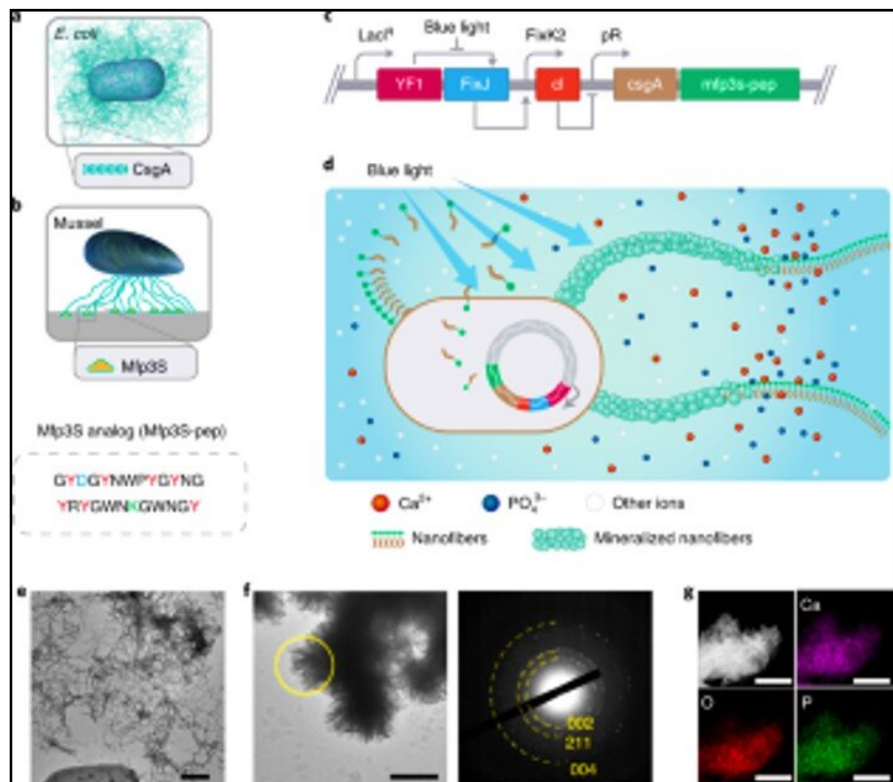
## Light-responsive *E. coli* functional biofilms as scaffolds for hydroxyapatite mineralization

By Thamarasee Jeewandara

Living organisms have evolved mechanisms of biomineralization to build structurally ordered and environmentally adaptive composite materials. While research teams have significantly improved biomimetic mineralization research in the lab, it is still difficult to engineer mineralized composites with structural features and living components much like their native counterparts. In a new report now published on *Nature Chemical Biology*, Yanyi Wang and a research team in physics, advanced materials, synthetic biology, and engineering in China, developed living patterned and gradient composites inspired by natural graded materials. They coupled light-inducible bacterial biofilm formation with biomimetic hydroxyapatite (HA) mineralization in this work, to show how the location and degree of mineralization could be controlled. The cells in the composites remained viable while sensing and responding to environmental signals. The composites showed a 15-fold increase in Young's modulus (i.e., stiffness, the ratio between stress and strain) after mineralization. The work sheds light to develop living composites with dynamic responsiveness and environmental adaptability.

### Biominingeralization in the lab

Living organism can produce a variety of hierarchical organic-inorganic composite structures based on biomineralization, where notable examples include the radular teeth of chitons, fish scales and crayfish mandibles that fulfill diverse biological functions. The timing and degree of biomineralization must be precisely controlled by cells to form accurate structures and functions in living organisms. Recent research in biomimetic mineralization had highlighted the importance of exploring



cell-controlled approaches to produce living patterns and graded composites as a promising yet largely unexplored area. The disciplines of synthetic biology and materials science have unleashed a range of sophisticated and environmentally friendly gene circuits to bioengineer a range of new

cellular functions. In this work, Wang et al. developed bioinspired, living composite materials by harnessing light-inducible *Escherichia coli* biofilms coupled with biomimetic mineralization. The work will open doors to integrate engineered cells to produce mineralized materials with structural and living features.

### **Selecting protein modules for hydroxyapatite (HA) mineralization and developing a light-sensitive biofilm**

The team selected fusion proteins to engineer mineralization promoting *E. coli* biofilms. Based on previous experiments, they selected protein Mefp5 – originating from *Mytilus edulis*, followed by Mfp3S – originating from *Mytilus californianus* and another variant of the Mfp3S peptide (Mfsp3S-pep) to initiate mineralization and promote adhesion. The team constructed fusion proteins containing a major protein domain of the *E. coli* biofilm to form CsgA-Mfp fusion proteins and confirmed their potential secretion from engineered cells. They then selected the CsgA-Mfp3S-pep fusion protein as a representative for hydroxyapatite mineralization and conducted experiments to verify the function of the protein to highlight their role during mineralization and crystal formation. Thereafter, Wang et al. constructed a light-inducible biofilm-forming strain named light<sub>receiver</sub>-CsgA-Mfp3S-pep that can be tightly regulated via blue light illumination.

The light-sensitive strain could generate functional biofilm materials after illumination with light to promote the mineralization of hydroxyapatite (HA). To validate this, the scientists exposed the light-sensitive strain to blue light in a Petri dish and used histological staining and transmission electron microscopy (TEM) imaging to show the production of amyloid fibers in the biofilms. Comparatively, they did not observe amyloid fibers in samples grown in the dark. The engineered extracellular matrix also acted as a template for HA mineralization in time, which they confirmed after 7-days of incubation based on X-ray diffraction (XRD) and energy-dispersive X-ray spectroscopy (EDS) techniques.

### **Forming controlled living composites**

Based on the light-sensitive nature of the engineered biofilms, Wang et al. manipulated biofilm formation in space-time to control the formation of composites. They accomplished this by illuminating a leaf pattern on liquid bacterial cultures in polystyrene petri dishes that faithfully recapitulated the projected light pattern on to the bacterial biofilms. After 7-days of mineralization, the composite generated in the petri dishes retained the original pattern as observed using scanning electron microscopy. The light-regulated approach controlled the shape of the composite based on grid-pattern projections and spatial resolution of light in the microscale—comparable to the size of the living bacteria. The team then verified the viability of live, intact cells by engineering the living composites to express fluorescent proteins, as confirmed using confocal microscopy images. Thereafter, they used thermogravimetric analysis to quantify the inorganic components of mineralized composites, where the inorganic material increased proportionally with time on immersion in simulated body fluid (SBF). Wang et al. also compared the Young's modulus of the biofilm using a micro-indentation technique to show how mineralization strengthened the *E. coli* biofilms to protect the cells.

### **Density controlled gradient composites**

Tissue engineering approaches have emphasized the need to precisely identify between hard and soft tissues for successful physiological performance, therefore the light intensity could be tuned to control the density and mechanical properties of engineered living materials. Zhang et al. accomplished this by exposing *E. coli* cultures to different intensities of illumination to reveal how biofilm thickness decreased with the decreasing intensity of blue light. They further showed how mineralization was tightly and locally directed by the engineered Mfsp3S-pep fusion proteins. Then they studied the local mechanical properties of illuminated regions with micro-indentation to observe a fourfold increase in Young's modulus to highlight living composites engineered with tunable mineral gradients and mechanical properties for regenerative tissue-to-bone interfaces in bone tissue engineering applications.



## Deploying living composites for site-specific damage repair

The scientists also studied the capacity for the engineered biofilms to aggregate for damage repair by gluing polystyrene microspheres, alongside HA-mineralization. As proof-of-concept, they applied living mineralized composites to fill and repair cracks engineered on the surface of a polystyrene Petri dish. During the experiments, the light-induced adhesive biofilms captured microspheres in solution to fill the purposely created damaged furrow, while nanofibers in biofilms acted as a template for hydroxyapatite mineralization to consolidate light-induced cementation under blue light illumination. Using scanning electron microscopy, Wang et al. showed how bacteria and the surrounding extracellular matrix adhered together with microspheres to illustrate the adhesive function of the living biofilms. The HA-mineralized composites formed dense, concrete-like layers that filled the damaged furrow to highlight the mineralization functionality of the living composites for enhanced durability and repair applications.

### Outlook

In this way, Yanyi Wang and colleagues produced bioinspired living patterned composites and living graded composites with a light-regulated biofilm platform. The resulting composites displayed environmental responsiveness similar to their native counterparts. The cells within the composites remained viable and responded to environmental stimuli even after mineralization. The work opens a path to create living, functional organic-inorganic composites with adaptive and self-repairing features with applications across biomedicine, regenerative medicine, and bioremediation.

**More information:** Wang Y. et al. Living materials fabricated via gradient mineralization of light-inducible biofilms, *Nature Chemical Biology*, doi: [doi.org/10.1038/s41589-020-00697-z](https://doi.org/10.1038/s41589-020-00697-z)

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**Journal information:** [Nature Chemical Biology](#) , [Nature](#) , [Science](#)  
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## COVID-19 Research News



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## New research may explain severe virus attacks on lungs

*In some cases, immune cells in the lungs can contribute to worsening a virus attack. In a new study, researchers at Karolinska Institutet in Sweden describe how different kinds of immune cells, called macrophages, develop in the lungs and which of them may be behind severe lung diseases*

Stockholm: In some cases, immune cells in the lungs can contribute to worsening a virus attack. In a new study, researchers at Karolinska Institutet in Sweden describe how different kinds of immune cells, called macrophages, develop in the lungs and which of them may be behind severe lung diseases.

The study, which was published in *Immunity*, may contribute to future treatments for Covid-19, among other diseases.

The structure of the lungs exposes them to viruses and bacteria from both the air and the blood. Macrophages are immune cells that, among other things, protect the lungs from such attacks. But under certain conditions, lung macrophages can also contribute to severe lung diseases, such as chronic obstructive pulmonary disease (COPD) and Covid-19.

To date, research on the development of human lung macrophages has been limited.

Macrophages can have different origins and develop, among other things, from white blood cells, monocytes, that are divided into different genetically determined main types. In humans, two of these are “classical” CD14+ monocytes and “non-classical” CD16+ monocytes.

In a new study at Karolinska Institutet, researchers have used a model to study the development of lung macrophages directly in a living lung. This has been combined with a method to study gene activity in individual cells, RNA sequencing, and thereby discovered how blood monocytes become human lung macrophages.



In some cases, immune cells in the lungs can contribute to worsening a virus attack.(Yahoo)

“In our study, we show that classical monocytes migrate into airways and lung tissue and are converted into macrophages that protect the health and function of the lungs. We have also identified a special kind of monocyte, HLA-DRhi, which is an intermediate immune cell between a blood monocyte and an airway macrophage. These HLA-DRhi monocytes can leave the blood circulation and migrate into the lung tissue,” says Tim Willinger, Associate Professor at the Department of Medicine, Huddinge, Karolinska Institutet, who led the study.

The non-classical monocytes, however, develop into macrophages in the many blood vessels of the lungs and do not migrate into the lung tissue.

“Certain macrophages in the lungs probably have a connection to a number of severe lung diseases. In respiratory infections, for example, monocytes in the lungs develop into macrophages, which combat viruses and bacteria. But a certain type of macrophage may also contribute to severe inflammation and infections,” says the study’s first author Elza Evren, a doctoral student in Tim Willinger’s research team.

In an infection with the novel coronavirus, SARS-COV-2, which causes Covid-19, researchers believe that protective, anti-inflammatory macrophages are replaced by pro-inflammatory lung macrophages from blood monocytes.

“The existence of these blood monocyte-derived macrophages has been shown in other studies to correlate with how severely ill a person becomes in Covid-19 and how extensive the damage to the lungs is. Patients with severe Covid-19 also have fewer HLA-DRhi monocytes in their blood, probably because they move away from the blood into the lungs. Given their important role in rapid inflammatory responses, our results indicate that future treatments should focus on inflammatory macrophages and monocytes to reduce lung damage and mortality from severe Covid-19,” says Tim Willinger.

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

<https://www.hindustantimes.com/science/new-research-may-explain-severe-virus-attacks-on-lungs/story-OVTnEzViKspBZsayK9bs2N.html>

