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# समाचार पत्रों से चयित अंश
# Newspapers Clippings

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THE TIMES OF INDIA

***Sun, 08 May 2022***

# DRDO's SFDR flight test successful

Defence Research and Development Organisation (DRDO ) has successfully flight-tested Solid Fuel Ducted Ramjet (SFRD) booster at the Integrated Test Range (ITR), Chandipur off the coast of Odisha on Friday. The SFDR has been developed by Defence Research and Development Laboratory, Hyderabad in collaboration with other DRDO laboratories such as Research Centre Imarat, Hyderabad and High Energy Materials Research Laboratory, Pune.

Complimenting the teams involved in design, development and testing, Secretary, Department of Defence R&D and Chairman DRDO Dr G Satheesh Reddy said, with the successful trial of SFDR, the range of air-to-air missiles can be enhanced. “The test successfully demonstrated the reliable functioning of all critical components involved in the complex missile system and met all the mission objectives,” the ministry of defence said. The SFDR-based propulsion enables the missile to intercept aerial threats at very long range at supersonic speeds. The performance of the system has been confirmed from the data captured by a number of range instruments like Telemetry, Radar and Electro Optical Tracking Systems deployed by ITR. Defence minister Rajnath Singh congratulated DRDO for the successful trial of SFDR. He termed it as an important milestone toward the development of critical missile technologies in the country.

*https://timesofindia.indiatimes.com/india/drdos-sfdr-flight-test-successful/articleshow/90733566.cms?from=mdr*

THE ECONOMIC TIMES

***Sat, 07 May 2022***

# From missiles to glide bombs, India set to test several advanced weapon systems

India is getting set to conduct a slew of tests of several indigenously-developed advanced weapons, ranging from air-to-air missiles and anti-radiation missiles to smart anti-airfield weapons and long-range glide bombs. The tests of at least three weapons, the Astra-1 (100-km range) and Astra-2 (160-km) beyond visual range air-to-air missiles (BVRAAMs) as well as the new generation antiradiation missile (NGARM) Rudram-1 with a strike range of 150-km, are slated for this month, defence sources told TOI. The Astra-2 will undergo its “first live launch” from a Sukhoi30MKI fighter after completion of its carriage and handling trials as well as “dummy drops”. The Astra-1, already under production by defence PSU Bharat Dynamics after

the successful completion of its user trials, in turn will be tested for the first time with an indigenous seeker instead of the existing Russian AGAT one from a jet. The has already placed an initial order for 250 Astra-1 missiles, which flies over four times the speed of sound at Mach 4.5, to arm its Sukhoi fighters.

The integration of Astra1 with the Tejas and MiG-29 fighters is also concurrently underway. is also planning to conduct the first test of Astra-3, based on the solid fuel-based ducted ramjet ( ) propulsion to enhance its range to 350-km, by the end of this year, the sources said. The all-weather day and night capable Astra series of missiles, designed to detect, track and destroy highly-agile supersonic fighters packed with "counter-measures'' at long ranges, will eventually replace the expensive Russian, French and Israeli BVRAAMs that are currently imported to arm IAF fighters. Another test this month will be of the Rudram-1 NGARM that is designed to destroy a variety of enemy surveillance, communication and radar targets on the ground at a 150-km range after being fired from fighter jets. DRDO is also developing Rudram-2 (350-km range) and Rudram-3 (550-km) air-to-ground missiles, which also have INS-GPS navigation with a passive homing head for the final attack

"Trials of Rudram-2 should also begin soon. Rudram missiles are designed for suppression of enemy air defences (SEAD) from longer stand-off ranges to allow IAF strike aircraft to carry out their bombing missions without hindrance," a source said. Then, tests of smart anti-airfield weapons (SAAW), which are precision-guided bombs designed to destroy enemy runways, bunkers, aircraft hangers, radars and other reinforced structures at a range of 100-km, are also in the pipeline. "These are 125-kg glide bombs, based on two configurations of either satellite navigation or electro-optical imaging infrared seeker (EOIIR), carried on racks in fighters like Sukhois or Jaguars. A single Sukhoi can carry 32 such bombs. Separately, 1000-kg heavy calibre glide bombs, with a 80-km range, are also being developed," he added.

*https://timesofindia.indiatimes.com/india/india-all-set-to-test-several-homemade-weapon-systems/articleshow/91394150.cms*

# Defence News

# Defence Strategic: National/International

THE ECONOMIC TIMES

***Sat, 07 May 2022***

## Army vice chief pitches for indigenous defence production

In a bid to ensure the country's self-reliance in defence, the Indian Army has signed contracts worth Rs 40,000 crore with indigenous defence manufacturers, Vice Chief of Army Staff Lieutenant General B S Raju said on Saturday. Lt Gen Raju, in his address to Army commanders, said henceforth, the "Acceptance of Necessity (AoN)" will only be given to indigenous defence manufacturers, adding that the direction "from the top" was very clear that the country had to fight any future war with indigenous equipment.

The Ministry of Defence grants AoN for a particular weapon system or equipment at the beginning of the procurement process. This is part of the government's support to encourage the defence manufacturing industry in the country, which is at a nascent stage. Inaugurating the North Tech symposium, Lt Gen Raju said, "The Indian Army has entered into contracts worth Rs 40,000 crore with the indigenous defence industry during the last two years."

In a word of support for the industry, the vice chief said, "You have some experience. We assure you that we will come more than half a distance to meet your aspirations. We will give you all facilities that are required -- whether it is equipment or testing ranges or our time." "We will not ask you for the moon. It will be reasonable, so that we are able to produce. If your equipment meets 80 per cent of aspiration, we are going to give you orders. I assure you," he added. Lt Gen Raju said as part of an outreach initiative towards the industry, the Army has established a regional technology node in Pune in addition to the one already in place in Delhi.

"We are planning to have one in Bengaluru. Our army design bureau is doing a fantastic job. We need to scale up our in-house capabilities," he said. On the second day of the symposium, an exhibition was organised, wherein 162 companies from the Indian defence industry, including MSMEs, DRDO and DPSU, participated and exhibited their products. In addition, 42 innovative solutions by Army establishments towards enhancement of their combat potential were also on display, a defence spokesman said. On the first day of the symposium, participants from the Army and the defence manufacturing industry discussed policies and procedures for expeditious procurement, self-reliance in defence initiatives by the Indian Army, DRDO and Defence Public Sector Undertakings among others, a spokesman said.

The symposium showcased cutting-edge technologies and innovative products providing solutions to some of the complex challenges faced by the security forces in the Northern Command and also acted as an ideal platform for mutual exchange of ideas between the domestic defence industry and the Army, he said. The technologies and products on display covered a wide canvas, the prominent ones being surveillance and situational awareness, tactical mobility, firepower, force protection, communications, combat medical facility, robotics and simulators. Representatives from the Indian Defence Industry, Defence Research and Development Organisation (DRDO), Defence Public Sector Undertakings and academia participated in the symposium and presented their thoughts.

*https://economictimes.indiatimes.com/news/defence/army-vice-chief-pitches-for-indigenous-defence-production/articleshow/91403923.cms*

IDN INDIAN DEFENCE NEWS
Global Defence, Aerospace & Security

***Sun, 08 May 2022***

# Meet *'Vibhram'*, The 'Made in India' UAV helicopter built for army

Aiming to promote the government's quest for the *Aatmanirbhar Bharat* initiative in defence technology and reduce dependency on foreign countries, the Indian Army's Northern Command organised a two-day North Tech Symposium wherein a number of technologies were showcased at Udhampur, Jammu. Among the technologies displayed was *'Vibhram'* -- Indian start-up EndureAir's High-Efficiency Dissimilar Coaxial Helicopter. The helicopter has been designed in

collaboration with the Indian Institute of Technology-Kanpur. In August 2017, *'Vibhram'* won the third prize in the 34th Annual Student Design Competition organised by the American Helicopter Society. On January 8, 2021, the design was shown to late Chief of Defence Staff General Bipin Rawat on the occasion of Army Technology Day. Later, it was displayed on January 15 on Army Day.

**Unmanned Drone Helicopter *'Vibhram'*:**

*'Vibhram'* is a high-endurance multi-role gasoline-powered Unmanned Aerial Vehicle designed to meet a variety of applications. It has a two-hour hovering endurance with a day and night camera payload that can be useful for purposes like surveillance, chemical, biological, radiological, nuclear and high yield explosives detection, crowd monitoring, pipeline inspection, and forest fire detection among others. It can carry four kilograms of payload at sea level at a speed of 70 km/h for long-range payload delivery and surveillance from a long standoff distance. It is fitted with a fully functional and robust autopilot system. The autopilot system also includes multiple redundant fail-safe measures, which makes it a reliable tool in critical applications. The drone is said to be around 20 per cent more efficient than the existing motor design like the traditional single main rotor and tail rotor and the Regular coaxial design. It can be used by the army and the Air Force. It consumes less fuel in comparison to traditional helicopters.

**Meet Team *'Vibhram'* From IIT-Kanpur**

The team is headed by Karthik S, who is pursuing MTech while Rahul Ramanujam is the technical leader, PhD). Among other members include, Ramdas (PhD), Diksha Aggarwal (MTech), Sakshi Gupta (MTech), Avinash Shet (MTech), Vishesh Kumar Singh (MTech), and Naba Kishore Routray (MTech). They all are from the Aerospace Engineering Department of IIT Kanpur. The project was carried out under the guidance of Prof Venkatesan and Prof Abhishek. The Symposium focussed on the government's vision of self-reliance in defence technologies. North Tech Symposium 2022 showcased cutting edge technologies providing solutions to the operational challenges faced by Northern Command.

*http://www.indiandefensenews.in/2022/05/meet-vibhram-made-in-india-uav.html*

FINANCIAL EXPRESS
Read to Lead

***Sun, 08 May 2022***

# India's Defence and business delegation to visit Brazil, explore opportunities in Defence sector

Confirming this to Financial Express Online, a senior officer said, "A delegation of senior officials led by Sanjay Jaju, Additional Secretary (Defence Production), Ministry of Defence (MoD) and representatives of several public and private sector companies from the defence sector will travel under the umbrella of FICCI." Later this month, a large official and business delegation is heading to South American nation Brazil to explore the possibilities of joint production, joint development of various defence weapons and platforms.

Confirming this to Financial Express Online, a senior officer said, "A delegation of senior officials led by Sanjay Jaju, Additional Secretary (Defence Production), Ministry of Defence (MoD) and representatives of several public and private sector companies from the defence

sector will travel under the umbrella of FICCI." "There will be around 10-12 companies including public and private sector as well as start-ups from the defence sector," confirmed a senior official from the industry body FICCI.

**Which companies are going?**

Armoured Vehicles Nigam Limited; Bharat Dynamatics Limited; Bharat Electronics Limited; C2C DB Systems; Centum Electronics; Dhruva Aerospace; GRSE; Larsen & Toubro Limited; Maharashtra Minerals Corporation Limited; Mazagon Dock Shipbuilders; MKU Limited; Ocean Marine Environment Coatings Pvt Ltd; Pushkak Products Pvt Ltd; SMPP Pvt Ltd; SSS Defence and more.

**What is the agenda of the delegations going to Brazil?**

The delegation is heading to Rio de Janeiro, Brasilia, and Sao Paulo. The official delegation, according to sources, will be meeting with the top leadership of the Brazilian forces and other senior officials and presentations will be made by the Indian companies before travelling to other locations. On June 2, all the private and public sector companies will visit Sao Jose dos Campos, where all Defence Industries are located, and Technology Park too where the Indian companies will make presentations. The delegation will also be visiting different facilities of Embraer one in Sao Jos dos Campos and another one located in Gavio Paixito.

**South & Central America are looking for:**

Army: Rocket Launchers; Armoured Personnel Carrier; Body Armour and Helmets; Telescopic and IR Sights; Night Vision Devices; Surface to Surface Missiles. Navy: ASW Helicopters; Submarines; Cyber Defence Capability; MR & Surveillance Aircraft; Amphibious Ships; Modernisation of Frigates & OffShore Patrol Vessels.

**Air Forces: AWACS; Light Combat Aircraft; Light Combat Helicopters**

A government policy is already in place which has a new strategy for export of defence platforms and weapons to friendly nations. As has been reported by Financial Express Online earlier, there are many countries in the region including Brazil which are in the process of modernizing their military and police forces. And this has opened opportunities for the Indian companies to explore the market and identify partners for joint ventures.

**How many Indian defence companies are present in Brazil?**

So far only one Indian company has been present in almost all the countries in the region and it is Kanpur based MKU, a global leader in defense and homeland security solutions. This company has executed several contracts in Brazil – Military Police, the Army and Federal police. They also won a major contract in a competition to supply around 14,500 pieces of vest for Policia Militar do Estado de Sao Paulo, and also Brazilian Army commission Night vision monocular.

**BrahMos**

Both sides have been in discussion for the BrahMos-NG (New Generation) version of the short-range ramjet supersonic cruise missile. In a recent interaction with Financial Express Online, Atul Dinkar Rane DG BrahMos DRDO& CEO & MD BrahMos had confirmed that several countries from the region have sought more information about the missile. While he did not specially name the countries, Financial Express Online has reported earlier that several countries in the region have expressed interest in the Indo-Russia BrahMos.

**India-Brazil Defence Cooperation**

In 2020 both countries had signed the Plan of Action for the Brazil-India strategic partnership, at the end of talks between Prime Minister Narendra Modi and the Brazilian President Bolsonaro who had visited India as the chief guest at the Republic Day Parade. And under this Plan of Action defence and security are the main components, as both countries are complementary in this area.

**Interest in Make in India**

Top diplomats as well as senior officials of Brazil have expressed their interest to participate in joint ventures in the defence sector. For the Indian companies there is a lot scope under in Brazil's "Triple-Helix" approach, which is focused on R&D, Innovation for all the three services – Army, air Force and Navy, India's Ambassador Suresh K Reddy had explained earlier.

**Any Joint ventures between Indian & Brazilian Companies?**

Yes. Companhia Brasileira de Cartuchos (CBC) Brazil, the world's second-largest ammunition manufacturer, and Stumpp Schuele & Somappa India (SSS Defence) are in a joint venture to produce ammunition for all calibers like: 9 mm, 7.62×39 mm,7.62×51 mm, .338 Lapua and 12.7 mm. And, as per the terms of the joint venture can export to a third country after fulfilling India's requirements. Another Brazilian company Taurus Armas S.A. has tied up with Jindal Defence for manufacturing small arms.

*https://www.financialexpress.com/defence/indias-defence-and-business-delegation-to-visit-brazil-explore-opportunities-in-defence-sector/2516428/*

Hindustan Times

***Mon, 09 May 2022***

# Cabinet approves Haryana aerospace and Defence production policy 2022

The cabinet accorded its approval to Haryana Aerospace and Defence Production Policy, 2022 that aims to attract investments of at least one billion dollars and generate employment opportunities of around 25,000 persons in five years and to position the state as country's leading aerospace and defence manufacturing hub. The policy envisages harnessing Haryana's inherent strength in auto components and automobile manufacturing sector that looks forward to a possible transition into aerospace and defence manufacturing. The policy will also addresses the need of creating one world-class maintenance, repair and overhaul (MRO) facilities in Haryana. The state government will facilitate and incentivise the proposals for setting up of new MRO facilities at existing airports or at new locations in Haryana.

The policy places a special emphasis on development of the MSME sector and its business growth. It envisages bringing up a paradigm shift from being a regulator to a facilitator of MSMEs. Among the fiscal incentives offered under the policy are net SGST reimbursement for a certain duration, capital subsidy, employment generation subsidy, stamp duty reimbursement, 100% electricity duty exemption for 10 years, etc. 'MSMEs to get requisite business clearances within 15 days' To ease the regulatory burden on the investor and strengthen ease of doing business, the Haryana cabinet on Friday approved the Haryana Enterprises Promotion

(Amendment) Rules, 2021 for implementation of reforms proposed in the Haryana Enterprises and Employment Policy (HEEP), 2020.

As per the approved regulatory reforms of the policy, micro, small and medium enterprises (MSMEs) will be given all requisite business clearances within 15 days, beyond which, there will be a provision for automated deemed clearance on the HEPC portal.New industrial policy, namely Haryana Enterprises and Employment Policy, 2020, is effective from January 1, 2021, to December 12, 2025. The state government had enacted Haryana Enterprises Promotion Act, 2016 and corresponding rules, to create an ecosystem in which the ease of doing business in state reduces delay in granting clearances and approvals to enterprises as well as the cost of doing business in state. Illegally subdivided plots before 1980 to be regularised

The cabinet also approved a policy allowing regularisation of illegally subdivided plots and permitting plot owners to rationally subdivide the originally allotted plots. The regularisation, subdivision of plots located in the planned schemes prior to 1980 will only be considered under this policy, an official spokesperson said. The minimum plot size eligible for regularisation and new subdivision will be 200sq-m. The size of the subdivided plot will not be less than 100sq-m.

As per the policy, scrutiny fees of ₹10 per square meter will be charged. For regularisation of illegally subdivided plot, subdivision/license fees at the rate of 1.5 times of license fee for (residential plotted) notified by the town and country planning department from time to time will be applicable.

For fresh subdivision, license fee (residential plotted) as notified by the town and country planning department will be applicable. The spokesperson said plots in the planned scheme stand illegally subdivided as per their need by the resident and due to family partition the plots were subdivided illegally as there is no policy that allows subdivision in planned scheme.

The residents of such illegally subdivided plots are not able to get their building plan approved by their respective municipalities. They are constructing illegal structures in violation of the rules. Therefore, the policy for regularisation of illegal subdivision of plots and fresh subdivision of plots in town planning scheme, rehabilitation scheme, and improvement trust scheme situated in the municipal area of Haryana has been approved. ‘Contractors willing to work in Haryana need to register on portal’

Also, the contractors willing to work in Haryana will have to register on the Haryana Engineering Works (HEW) portal and the registered qualified contractors will be exempted from paying earnest money deposit (EMD). The decision taken in the cabinet meeting on Friday is aimed at providing a single window for contractors to bring in transparency and ease of doing business, the state government said in a release. While the registered qualified contractors will be benefitted since they are going to be exempted from paying EMD, the contractors not registered on the HEW portal can also participate in the tender. However, unregistered contractors on the portal will not be eligible for the EMD exemption benefit. Any registered contractor falling below the threshold limit score (70% in their performance score) will be auto de-registered on the HEW portal.

*https://www.hindustantimes.com/cities/chandigarh-news/cabinet-approves-haryana-aerospace-and-defence-production-policy-2022-101651867159601.html*

The Indian EXPRESS

*Sun, 08 May 2022*

# Almost all Defence orders will now go to domestic industry: Army Vice Chief

The Acceptance of Necessity (AoN) in future for almost all weapons and equipment will be given to the Indian industry, Vice Chief of Army Lt Gen BS Raju said this while inaugurating the North Tech Symposium in Udhampur on Saturday. "Future wars need to be fought with indigenous equipment," he said. An AoN is accorded by the Defence Ministry for a particular weapon system or equipment at the beginning of the procurement process. Over 150 Indian companies participated in the symposium, showcasing the technologies they have on offer to the Indian armed forces. Addressing the participants, Raju said, "Hereafter, the Acceptance of Necessity (AoN) will only be given to indigenous defence manufacturers. We will come more than half a distance to meet your aspirations. We will give you all the facilities that are required, whether it is equipment, testing facilities, and, most importantly, our time."

Raju told the industry members that the Army will "not ask you the moon" and the Preliminary Service Quality Requirements (PSQRs), the requirements that an equipment or weapon needs to meet, "that we are going to give are going to be reasonable so that you are able to produce". He said if the industry can meet 80 per cent of "our aspirations, then we will go ahead and issue orders". He later told journalists that the Army is working on making the PSQRs simpler. Army's strict PSQRs have been a cause of lament by many industry members. Speaking about the kind of technology the Army is looking for, Raju said, "We need drones of all kinds which are able to do persistent surveillance, carry payload, carry ammunition to the place of choice, secure communication, medical equipment, troops on ground need good habitat and so on."

Speaking to a few journalists, Northern Army Commander Lt Gen Upendra Dwivedi later said there are two immediate requirements that the Army is looking for. "The immediate requirements are what we were exporting from outside. And where we feel that the enemy has a technology which we need to counter. These are the two major criteria," he said. Lt Gen Dwivedi said the Army is looking for domestic alternatives to Special Clothing and Mountaineering Equipment (SCME), and surveillance equipment, such as drones. He said "because this technology is evolving every day, so whatever we are doing, the adversary is able to find a counter to it. We have to again look for a counter".

Dwivedi said that these technologies are being developed internationally, but "by the time they come here, they are obsolete, if I can say. Therefore, it is imperative for us to develop these technologies in India, so that we are also able to evolve and graduate to a higher level, in conjunction with what the adversary is doing, or even better than that".

*https://indianexpress.com/article/india/acceptance-of-necessity-weapons-indian-industry-vice-chief-of-army-7905741/*

The Tribune

*Sat, 07 May 2022*

# Indian army teams up with local units for buying Defence equipment

Backed by a policy that the import of defence equipment would be an exception, the Indian Army is working closely with the local industries for acquiring guns, missiles, ammunition, small UAVs, swarm drones, counter-drone systems, tank engines and vehicles. The locally-made INSAS rifles will be replaced by another indigenous product. The upgrade of several Russian equipment is being handled locally. Bulletproof jackets and a part of winter clothing are also no more imported. The Army is now looking at transfer of technology, joint ventures and R&D with the private industry for indigenous innovations, design and development to substantially enhance capability along the active borders.

At a tech exhibition in Udhampur yesterday, Lt Gen BS Raju, Vice Chief of the Army, met industry representatives and assured that Army's demands would be "reasonable". More than 160 industries participated with products on display included those for surveillance and situational awareness, tactical mobility, firepower, force protection, communications, combat medical facility, robotics and simulators. The message is clear, the Army is committed to the "Atmanirbhar Bharat Abhiyan". The Army has been delegated limited financial powers, which already resulted in purchases worth about Rs 2,200 crore.

A number of indigenous design and development projects have been successfully completed with exclusive proprietary rights. The focus areas are multi-capacity drones, UAVs, counter-drone UAV systems with various capacities, more accurate small arms, better protective equipment, longer reach and advance artillery weapon systems, air defence systems covering entire range of threat spectrum, more potent and futuristic electronic warfare measures and better communication. The Army has prioritised its procurement from the local industry and is handholding numerous indigenisation projects right from design and development stage till the final trials. Several endeavours have been undertaken to boost self-reliance in the defence sector.

*https://www.tribuneindia.com/news/nation/army-teams-up-with-local-units-for-buying-defence-equipment-393061*

*Sat, 07 May 2022*

# Light-infused hybrid particles speed energy transfer in organic semiconductors

Polaritons offer the best of two very different worlds. These hybrid particles combine light and molecules of organic material, making them ideal energy transfer vessels in organic semiconductors. They are both compatible with modern electronics but also move speedily, thanks to their photonic origins. However, polaritons are difficult to control, and much of their behavior is a mystery. A project led by Andrew Musser, assistant professor of chemistry and chemical biology in the Cornell University College of Arts and Sciences, has found a way to tune the speed of this energy flow. This "throttle" can move polaritons from a near standstill to something approaching the speed of light and increase their range – an approach that could eventually lead to more efficient solar cells, sensors, and LEDs.

The team's paper, "Tuning the Coherent Propagation of Organic Exciton-Polaritons through Dark State Delocalization," was published on April 27, 2022, in the journal *Advanced Science*. The lead author is Raj Pandya of the University of Cambridge. Over the last several years, Musser and colleagues at the University of Sheffield have explored a method of creating polaritons via tiny sandwich structures of mirrors, called microcavities, that trap light and force it to interact with excitons – mobile bundles of energy that consist of a bound electron-hole pair.They previously showed how microcavities can rescue organic semiconductors from "dark states" in which they don't emit light, with implications for improved organic LEDs.

For the new project, the team used a series of laser pulses, which functioned like an ultrafast video camera, to measure in real time how the energy moved within the microcavity structures. But the team hit a speedbump of their own. Polaritons are so complex that even interpreting such measurements can be an arduous process. "What we found was completely unexpected. We sat on the data for a good two years thinking about what it all meant," said Musser, the paper's senior author. Eventually the researchers realized that by incorporating more mirrors and increasing the reflectivity in the microcavity resonator, they were able to, in effect, turbocharge the polaritons.

"The way that we were changing the speed of the motion of these particles is still basically unprecedented in the literature," he said. "But now, not only have we confirmed that putting materials into these structures can make states move much faster and much further, but we have a lever to actually control how fast they go. This gives us a very clear roadmap now for how to try to improve them." In typical organic materials, elementary excitations move on the order of 10 nanometers per nanosecond, which is roughly equivalent to the speed of world-champion sprinter Usain Bolt, according to Musser. That may be fast for humans, he noted, but it is actually quite a slow process on the nanoscale. The microcavity approach, by contrast, launches polaritons a hundred-thousand times faster – a velocity on the order of 1% of the speed of light.

While the transport is short lived – instead of taking less than a nanosecond, it's less than picosecond, or about 1,000 times briefer – the polaritons move 50 times further.

"The absolute speed isn't necessarily important," Musser said. "What is more useful is the distance. So if they can travel hundreds of nanometers, when you miniaturize the device – say, with terminals that are 10's of nanometers apart – that means that they will go from A to B with zero losses. And that's really what it's about."

This brings physicists, chemists and material scientists ever closer to their goal of creating new, efficient device structures and next-generation electronics that aren't stymied by overheating. "A lot of technologies that use excitons rather than electrons only operate at cryogenic temperatures," Musser said. "But with organic semiconductors, you can start to achieve a lot of interesting, exciting functionality at room temperature. So these same phenomena can feed into new kinds of lasers, quantum simulators, or computers, even. There are a lot of applications for these polariton particles if we can understand them better."

*https://scitechdaily.com/light-infused-hybrid-particles-speed-energy-transfer-in-organic-semiconductors/amp/*

***Sun, 08 May 2022***

# Breakthrough in battery design: First realistic portraits of squishy layer that's key to battery performance

Lithium metal batteries might store much more charge in a given space than lithium-ion batteries can today, and the race is on to create them for next-generation electric cars, electronics, and other applications. But one of the roadblocks is a silent battle between two of the battery's components. The electrolyte, the liquid between the two electrodes, corrodes the surface of the lithium metal anode, covering it in a thin layer of gunk known as the solid-electrolyte interphase, or SEI. Although the formation of SEI is thought to be unavoidable, researchers want to stabilize and manage the growth of this layer in order to maximize the battery's performance. But they've never had a clear image of what the SEI looks like when it's saturated with electrolyte, as it would be in a working battery.

Now, researchers from the Department of Energy's SLAC National Accelerator Laboratory and Stanford University have made the first high-res images of this layer in its natural plump, squishy state. This advance was made possible by cryogenic electron microscopy, or cryo-EM, a revolutionary technology that reveals details as small as atoms. The results, they said, suggest that the right electrolyte can minimize the swelling and improve the battery's performance – giving scientists a potential new way to tweak and improve battery design. They also give researchers a new tool for studying batteries in their everyday working environments. The team described their work in a paper published in *Science* on January 6th, 2022.

"There are no other technologies that can look at this interface between the electrode and the electrolyte with such high resolution," said Zewen Zhang, a Stanford PhD student who led the experiments with SLAC and Stanford professors Yi Cui and Wah Chiu. "We wanted to prove that we could image the interface at these previously inaccessible scales and see the pristine,

native state of these materials as they are in batteries." Cui added, "We find this swelling is almost universal. Its effects have not been widely appreciated by the battery research community before, but we found that it has a significant impact on battery performance."

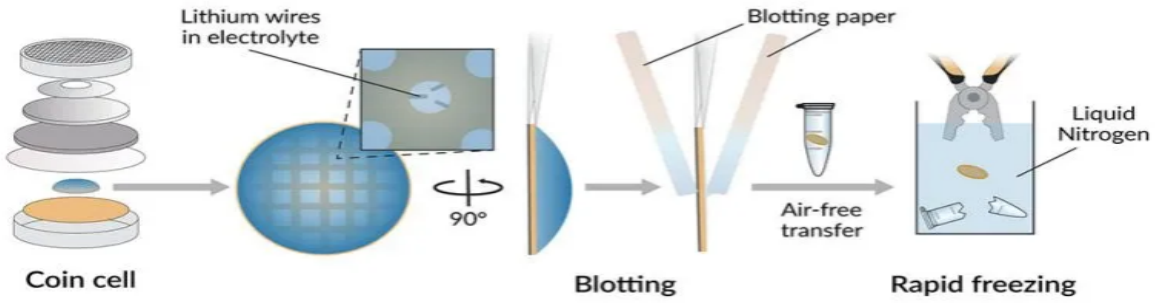
**A 'thrilling' tool for energy research**

This is the latest in a series of groundbreaking results over the past five years that show cryo-EM, which was developed as a tool for biology, opens "thrilling opportunities" in energy research, the team wrote in a separate review of the field published in July in *Accounts of Chemical Research*. Cryo-EM is a form of electron microscopy, which uses electrons rather than light to observe the world of the very small. By flash-freezing their samples into a clear, glassy state, scientists can look at the cellular machines that carry out life's functions in their natural state and at atomic resolution. Recent improvements in cryo-EM have transformed it into a highly sought method for revealing biological structure in unprecedented detail, and three scientists were awarded the 2017 Nobel Prize in chemistry for their pioneering contributions to its development.

Inspired by many success stories in biological cryo-EM, Cui teamed up with Chiu to explore whether cryo-EM could be as useful a tool for studying energy-related materials as it was for studying living systems. One of the first things they looked at was one of those pesky SEI layers on a battery electrode. They published the first atomic-scale images of this layer in 2017, along with images of finger-like growths of lithium wire that can puncture the barrier between the two halves of the battery and cause short circuits or fires. But to make those images they had to take the battery parts out of the electrolyte, so that the SEI dried into a shrunken state. What it looked like in a wet state inside a working battery was anyone's guess.

**Blotter paper to the rescue**

To capture the SEI in its soggy native environment, the researchers came up with a way to make and freeze very thin films of the electrolyte liquid that contained tiny lithium metal wires, which offered a surface for corrosion and the formation of SEI. First, they inserted a metal grid used for holding cryo-EM samples into a coin cell battery. When they removed it, thin films of electrolyte clung to tiny circular holes within the grid, held in place by surface tension just long enough to perform the remaining steps. However, those films were still too thick for the electron beam to penetrate and produce sharp images. So Chiu suggested a fix: sopping up the excess liquid with blotter paper. The blotted grid was immediately plunged into liquid nitrogen to freeze the little films into a glassy state that perfectly preserved the SEI. All this took place in a closed system that protected the films from exposure to air.




In next-gen lithium-metal batteries, the liquid between the electrodes, called the electrolyte, corrodes the surfaces of electrodes, forming a thin, squishy layer called SEI. To make atomic-scale images of this layer in its native environment, researchers inserted a metal grid into a working coin cell battery (left). When they removed it, thin films of electrolyte clung to tiny circular holes within the grid, held in place by surface tension, and SEI layers had formed on tiny lithium wires in those same holes. Researchers blotted away excess liquid (center) before plunging the grid into liquid nitrogen (right) to freeze the films into a glassy state for examination with cryo-EM. This yielded the first detailed images of the SEI layer in its natural swollen state. Credit: Zewen Zhang/Stanford University

The results were dramatic, Zhang said. In these wet environments, SEIs absorbed electrolytes and swelled to about twice their previous thickness. When the team repeated the process with half a dozen other electrolytes of varying chemical compositions, they found that some produced much thicker SEI layers than others – and that the layers that swelled the most were associated with the worst battery performance. “Right now that connection between SEI swelling behavior and performance applies to lithium metal anodes,” Zhang said, “but we think it should apply as a general rule to other metallic anodes, as well.”

The team also used the super-fine tip of an atomic force microscope (AFM) to probe the surfaces of SEI layers and verify that they were more squishy in their wet, swollen state than in their dry state. In the years since the 2017 paper revealed what cryo-EM can do for energy materials, it’s been used to zoom in on materials for solar cells and cage-like molecules called metal-organic frameworks that can be used in fuel cells, catalysis, and gas storage. As far as the next steps, the researchers say they’d like to find a way to image these materials in 3D – and to image them while they’re still inside a working battery, for the most realistic picture yet.

Yi Cui is director of Stanford’s Precourt Institute for Energy and an investigator with the Stanford Institute for Materials and Energy Sciences (SIMES) at SLAC. Wah Chiu is co-director of the Stanford-SLAC Cryo-EM Facilities, where the cryo-EM imaging work for this study took place. Part of this work was performed at the Stanford Nano Shared Facilities (SNSF) and Stanford Nanofabrication Facility (SNF). The research was funded by the DOE Office of Science.

*https://scitechdaily.com/breakthrough-in-battery-design-first-realistic-portraits-of-squishy-layer-thats-key-to-battery-performance/*

***Sat, 07 May 2022***

# Intelligent AI-empowered metasurface could revolutionize our lives

The manipulation of electromagnetic waves and information has become an important part of our everyday lives. Intelligent metasurfaces have emerged as smart platforms for automating the control of wave-information-matter interactions without manual intervention. They evolved from engineered composite materials, including metamaterials and metasurfaces. As a society, we have seen significant progress in the development of metamaterials and metasurfaces of various forms and properties.

In a paper published in the journal *eLight* on May 6, 2022, Professor Tie Jun Cui of Southeast University and Professor Lianlin Li of Peking University led a research team to review intelligent metasurfaces. “Intelligent metasurfaces: Control, Communication and Computing” investigated the development of intelligent metasurfaces with an eye for the future. This field has refreshed human insights into many fundamental laws. They have unlocked many novel devices and systems, like cloaking, tunneling, and holograms. Conventional structure-alone or passive metasurfaces has moved towards intelligent metasurfaces by integrating algorithms and nonlinear materials (or active devices). Intelligent metasurfaces have three crucial properties: digitalization, programmability, and intelligence. They provide an important opportunity to

control the interactions without human intervention. Digitalization enables the metasurface to encode, decode and store digital information. Programmability means that the metasurface can realize distinct functions with one physical entity. Intelligence indicates that the intelligent metasurface can make decisions, self-program, and perform successive tasks without human supervision.

Intelligence is the core, and algorithms can take this role well. Artificial intelligence (AI) has developed rapidly, particularly in data mining and knowledge discovery. Deep learning has proven extraordinarily useful in nearly every field of science and engineering. Deep learning has significantly positively impacted the metamaterials and metasurfaces field. It will undisputedly give birth to comprehensive and active research directions. n assessing the future of intelligent metasurfaces, the wireless signals that already exist in our lives could be vital to the field's further development. The development of 6G wireless communications, green IoT, and digital twinning is where intelligent metasurfaces could benefit.

We can envision that intelligent metasurfaces can learn, make decisions, self-programming, and continuously learn throughout their 'lifetime.' The intelligent metasurface is an emerging research direction involving various disciplines. There are a lot of open questions needed to be carefully addressed in the future.

*https://scitechdaily.com/intelligent-ai-empowered-metasurface-could-revolutionize-our-lives/amp/*