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DISCOVERIES OF THE SEEDS

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Learn more

Seed Fantasy — X-ray images of seeds from some 20 plant species, illustrated through artistic coloring, arraying and resizing. This is a prize-winning artwork of the 2013 Science Images Contest organized by Scientific American. [IMAGE: GBOWS]

Seed banks provide vital lifeline for future

Collections offer source of new hope in event of global catastrophe

Preserving plant seeds and other genetic material warrants investment of hundreds of millions of dollars, as it provides a lifeline for the future, according to scientists.

"If the world ends one day, these collections will bring hope of a new beginning to life on Earth," said Li Pei, a staff member at the Germplasm Bank of Wild Species (GBOWS) in Southwest China's Yunnan Province.

The Living Planet Report 2020 released by the World-Wide Fund for Nature warned that up to one million of the estimated eight million plant and animal species on Earth are at risk of extinction. Habitat loss, exploitation, climate change and pollution are the main causes. Numerous indicators, including the Living Planet Index provided by the Zoological Society of London, show there was an average 68 percent fall in nearly 21,000 wildlife populations from 1970 to 2016.

The rapid loss of biodiversity and germplasm resources is the main reason for the establishment of seed banks. There are now more than 1,750 such banks globally, according to the United Nations Food and Agriculture Organization.

Founded in 2007, GBOWS is a research and preservation facility for rare and endangered plants and animals.

It is the only comprehensive institution for storing wild plant and animal germplasm resources in China, and is the largest in Asia in terms of species, according to Li. Germplasm resources are strategically essential for global agricultural security.

Affiliated to the Kunming Institute of Botany (KIB) of the Chinese Academy of Sciences (CAS), GBOWS comprises a seed bank, a micropropagation unit, a plant DNA bank, a microbial bank based at Yunnan University, and an animal germplasm bank at CAS's Kunming Institute of Zoology (KIZ). It also boasts experimental research laboratories for plant genomics and seed biology.

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GBOWS has preserved 85,046 seed accessions from 10,601 species, 24,100 tissue samples from 2,093 species, 65,456 extracted samples of DNA material from 7,324 species, 22,800 strains of 2,280 microorganisms, and 60,262 bio samples of 2,203 wild animal species and domestic animal breeds.

Yu Fuqiang, deputy director of the germplasm bank, said, "The bank functions as a bio dome that protects wild organisms, especially those endangered species or species with high economic and scientific value, from extinction."

Li said: "As the genes of most plants are contained in their seeds, germplasm resources have become the carriers of plants' genetic information. A seed bank, which stores thousands of seeds, serves as the most important facility for preserving such resources."

A plant culture is examined by a scientist. [IMAGE: CHINA DAILY]

Race against time

In China, areas rich in biodiversity range from the dry northwest — even though it is surrounded by huge mountain ranges on the Qinghai-Tibet Plateau — to the tropical and subtropical south. The remote mountainous areas and diverse microclimates have resulted in high levels of endemism, which is the condition of being endemic, or restricted in geographical distribution to an area or region.

Li said the seed bank has preserved 85,046 accessions of 10,601 species, accounting for 36 percent of the seed plants in China. "The number of seed accessions is close to that of the world's biggest seed bank — the Millennium Seed Bank in the United Kingdom," Li said. "More important, this will play a crucial role for China's basic scientific research on wildlife."

With two in five plant species at risk of extinction, she said it is a race against time to protect the nation's incredible plant life.

"Wild species germplasm has great application potential in the biological sphere, especially for the collection and preservation of wild plants," Li said. "We store seeds that are collected in the wild so that we can germinate and reintroduce these plants to the wild or use them for scientific research in finding our future food and medicines, and for other functions."

For plants with tiny seeds that are difficult to store in a conventional seed bank — such as many endangered species from the orchid family — scientists freeze the tissue at a temperature of minus 196°C.

The first step

Collecting seeds is the first step of preservation, and GBOWS cooperates in this task with national partners who receive regular training from the seed bank.

Apart from seeds, collectors take specimens for verification. For future study, they record details of the plant, including where it was found, its size and the number of individual plants in the habitat.

This year, collectors from the bank visited many regions nationwide, including areas with low populations in West China and sinkholes in the south and southwest.

At sinkholes in Mengzi city, Yunnan, researchers found two rare plant species, *Petrocosmea grandiflora* and *Elaeagnus bambusetorum*, which had not been seen for more than 100 years.

Species are targeted and prioritized if they meet at least one of three standards — they are endangered, endemic or of economic importance. After arriving at the bank, the seeds undergo a series of processes before they can be stored long-term.

First, they are checked by botanists to ensure their "identity". Then, the seeds are slowly dried to five percent moisture content in a drying chamber, which maintains a temperature of 15°C and relative humidity of 15 percent.

The seeds are next cleaned before being weighed and counted manually, which is time-consuming and requires patience and an eye for detail.

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Then, the seeds are placed in suitable containers and weighed on an electronic scale under a plastic cover, which prevents the results being influenced by factors such as the air movement.

The weight of the seeds is recorded in grams correct to four decimal places — even more accurate than a scale for weighing gold.

Before being stored, the seeds receive an X-ray "health check". After this, they are photographed.

"For big seeds, an ordinary camera is enough, but for those with a diameter of one or two millimeters, photomicrography is used," said seed morphology researcher Li Lianyi. "Some tiny seeds cannot be seen by the eye, but photomicrography allows us to appreciate their spectacular shapes and colors."

After these procedures are completed, the seeds are sealed in glass bottles or jars. Each container has a barcode that can be scanned to enable scientists to view information about the seeds inside.

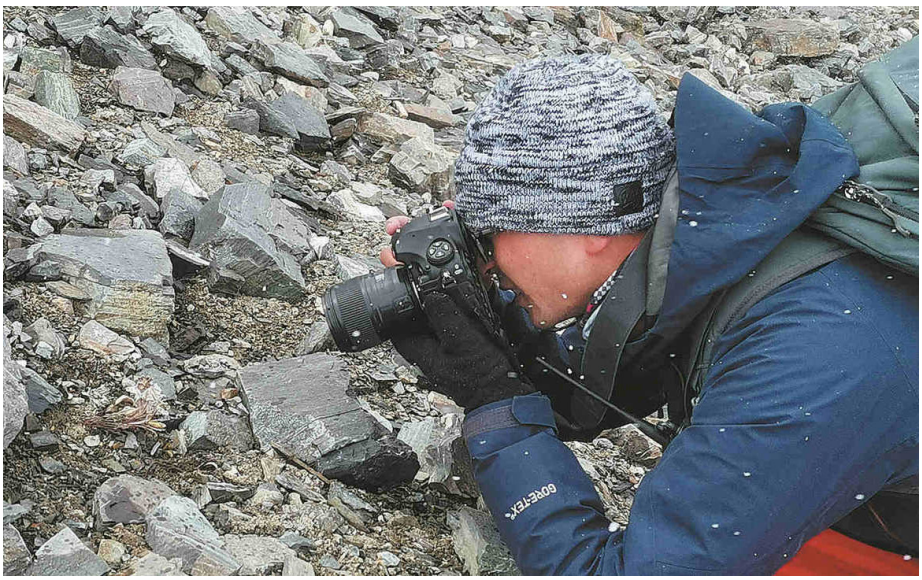
The containers, large and small, are stored in a huge chamber at a temperature of minus 20°C. Such chambers are freezers built underground to reduce the influence of the local environment.

The seed bank has five such chambers, covering a total of 190 square meters and capable of storing 170,000 collections.

Germination tests are conducted on a seed accession after it is banked to ascertain viability and to establish a germination protocol.

Seed revival is conducted on a palm-sized cell culture dish with agar, a gelatinous substance obtained from red seaweeds. In most cases, it usually takes a few days for the seeds to sprout.

"Some seeds remain dormant and need a little inducement to 'wake them up' — for example, a biological enzyme or an external force, such as chipping or breaking out the hard seed coating," seed curator Li Hui said that it sometimes takes four or five years for seeds without a germination study to revive. "For instance, some seeds only sprout through interaction with a biological enzyme found in the intestinal tracts of birds."



A scientist photographs plants on the slopes of Qomolangma, also known as Mount Everest.
[IMAGE: CHINA DAILY]

The bank has provided technical support for the preservation, research and use of China's wild plants. It also provides seed germination guidance services.

"Most of the orders are from forestry, grassland and agricultural colleges and research institutes," Li Hui said. "A test is usually conducted every five or 10 years after the seeds are stored to check their ability to grow. The result is a significant part of our research on the plant."

Partnerships at work

In addition to cooperating with 105 research institutes and preservation centers nationwide, the seed bank works with international partners, including Kew Gardens in the UK, on collecting backup specimens, exchanges and research.

It holds 2,176 sets of seeds from 45 countries, with each set containing thousands of individual seeds.

Li Pei, the staff member, said, "Duplication storage is widely used in case the seeds are destroyed in natural disasters, other accidents or in wars." She said wild plant protection is recognized globally as a crucial method of biodiversity conservation, as wild species have significant survival potential.

GBOWS has also made considerable efforts on DNA study and preservation of flora and fauna, she added, citing as an example protection of the Chinese yew — which is critically endangered and under top-level national preservation.

Li Pei added that "In the past, illegal traders processed the tree bark into powder to evade the forestry policy. Thanks to development of the DNA barcoding technique, we can now not only recognize the species that the powders are made from, but also source its provenance."

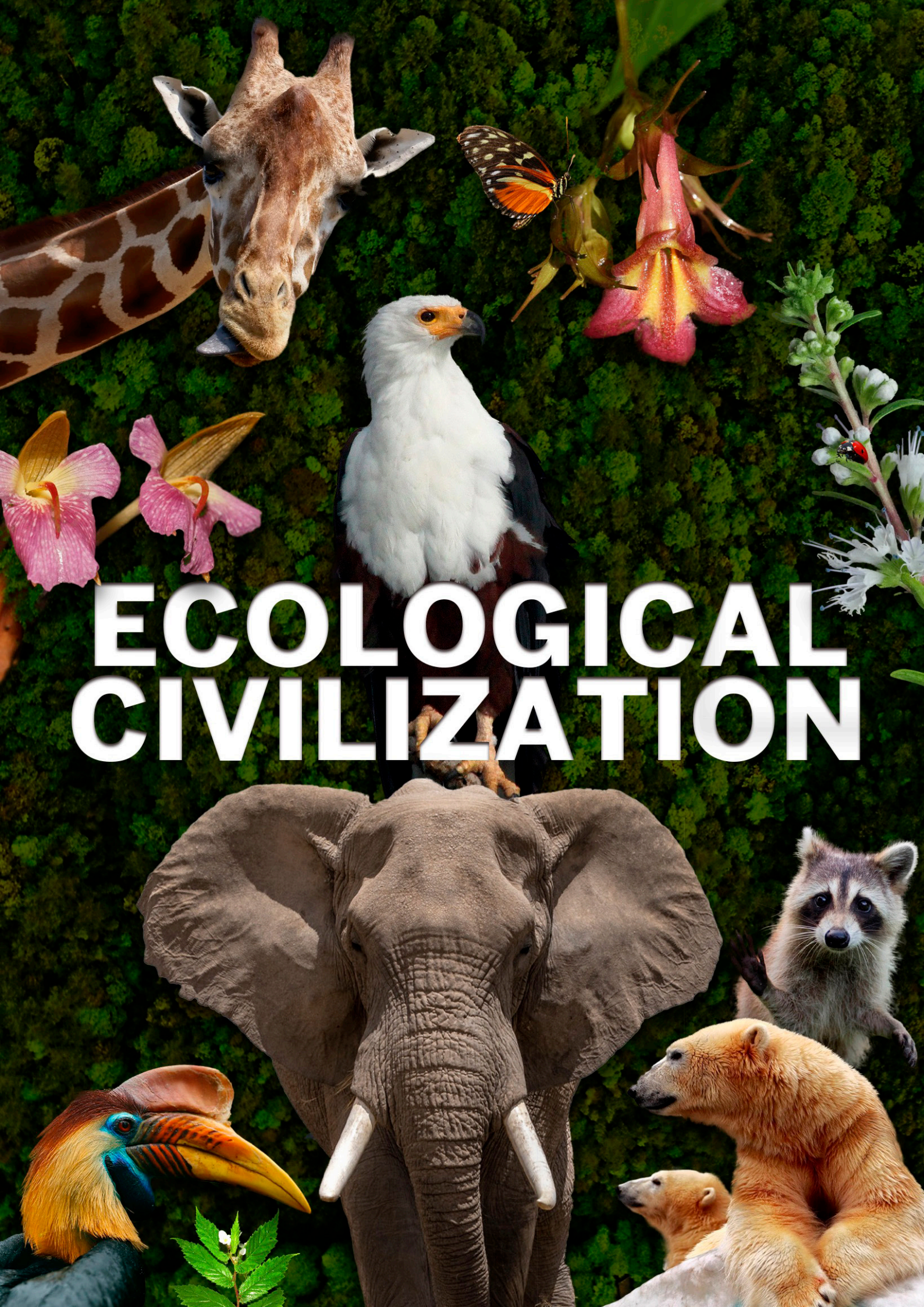
"As China has rich and unique biological resources, we aim to further enhance our collections and conduct deeper research, in expectation of contributing more to biodiversity conservation, not only in China but the world."

The aim of GBOWS is to conserve 19,000 species and 190,000 accessions in the next 15 years.

Source: China Daily

Saving Our Future

ZHONG JINYE / FOR CHINA DAILY


ECOLOGICAL
CIVILIZATION

The timeline of the development of the EC concept in China (above) and of SD globally (below) [IMAGE: *WEI ET AL*, NATL SCI REV, 2021, VOL. 8, NWAA279]

Ecological civilization: China's efforts to build a shared future for all life on Earth

Holistic thinking is required to integrate environmental goals with human activities and find better solutions for global challenges. These approaches include sustainable development (SD), planetary boundaries (PB) and ecological civilization (EC) based on the unity of nature and man (UNM).

The Convention on Biological Diversity (CBD) COP15, with the theme of 'Ecological civilization: building a shared future for all life on Earth' will review and adopt the post-2020 Global Biodiversity Framework (GBF), and set global goals for biodiversity conservation and sustainable use for the next decade and beyond.

Ecological Civilization and Sustainable Development

The term EC was put forth by a European researcher who encouraged self-sacrifice for the benefit of future generations. EC was first used in China in the 1980s as an academic concept and has been widely used in scientific publications since the 2000s. The idea has had a strong appeal in China as it is consistent with ancient Chinese Taoist philosophy.

As China's economy rapidly grew, China increasingly focused on addressing environmental challenges, and EC was proposed as an innovative way to reconcile the apparent contradiction between economic development and environmental protection at the 17th National Congress of the Communist Party of China in 2007. From then on President Xi has consistently championed its adoption and maturation, describing it as "vital for sustaining the development of the Chinese nation". EC was embedded in the country's constitution in 2018, and became the general national development strategy and cornerstone of the "New Era".

The Sustainable Development Goals (SDGs) are described by the UN as the blueprint for achieving a better and more sustainable future for all, and address global challenges related to poverty, inequality, climate change, environmental

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degradation, peace and justice. While EC and SD both seek to improve humanity's relationship with the environment and have many compatibilities, they are not identical concepts. SD seeks to reconcile the competing interests of society, the economy and the environment to identify the 'sweet spot' where they all come together synergistically.

EC has six core principles that are highly compatible with the SDGs. EC and the top-level design and strategic arrangements of the country's 'Five Sphere Integrated Plan' can be viewed as the Chinese means of fulfilling the SDGs. However, unlike the SDGs, in EC and those arrangements there is an additional emphasis on political and cultural aspects and on defining a new relationship between humanity and nature.

Experiences and Achievements of EC Development in China

Global leadership in afforestation

China launched large-scale national ecological restoration programs such as the Three-North Shelter Forest Program in 1978, which were followed by two of the largest conservation programs in the world: the Natural Forest Protection Project (1998), which banned logging, and the Grain to Green Program (2000), which incentivized afforestation. In addition, regional and local ecological restoration and afforestation projects have contributed to the 'greening' of China. Together, these restoration and afforestation projects have greatly increased forest coverage and ecosystem carbon sequestration and improved ecosystem services.

Promoting biodiversity conservation

While China rapidly industrialized and pursued numerous development projects, it also learned of the need to mitigate developmental impacts on biodiversity. China has rolled out a number of programs to address biodiversity issues, and the mainstreaming of biodiversity conservation has been embraced throughout all levels of government. In order to strengthen the effectiveness of its Protected Area (PA) system, which covers ~18 percent of the country's land, China has established a system of protected natural areas with national parks as its mainstay. Other accomplishments include the promulgation of laws, establishment of nature reserve networks, creation of national catalogues of species, assessment of threatened status of vertebrates, higher plants and macrofungi and setting of conservation priorities for them; and use of *in situ* and *ex situ* strategies to conserve genetic, species and ecosystem diversity. Many threatened species such as the giant panda, Père David's deer and the crested ibis have begun to recover and will likely avoid extinction.

The Ecological Conservation Redline

A focal point of EC is a national ecological conservation system called the Ecological Conservation Redline (ECR). The ECR, first proposed in 2011, was formally adopted in 2017, and its national impact on land is expected to be finished by 2020 while efforts to extend it into the marine realm are underway. The ECR is designed to constrain human activities in areas important to maintaining national ecological security that provide essential ecosystem services, including water and soil conservation, biodiversity maintenance, windbreaks and sand-fixation, and in ecologically fragile regions that are prone to soil erosion, desertification and salinization.

Fighting pollution

China's rapid industrialization and urbanization have given rise to pollution problems that affect both human health and biodiversity. Concerted efforts have been made since 2013 to improve air, soil and water quality. The Chinese government issued the Air Pollution Prevention and Control Action Plan, Water Pollution Prevention and Control Action Plan, and Soil Pollution Prevention and Control Action Plan, in 2013, 2015 and 2016, respectively. Specific targets and measures were adopted for each Action Plan to be reached and implemented by 2020 and 2030. A target of zero growth in chemical fertilizer and pesticide use by 2020 was set in 2015. Better definition of roles and responsibilities across levels of government has improved management and coordinated implementation. With the implementation of these Action Plans, air, water and soil quality in China have improved.

Implementing green development

China has proposed a comprehensive economic-ecological production framework called 'Gross Economic-Ecological Product Accounting' (GEEP) in its evaluation of local governments, which will help spark an industrial transformation and shift the economy to resource-saving and recycling, renewable energy and low-carbon emissions. Another approach recently adopted is to transform ecological advantages into economic ones. The Kubuqi Desert Eco-Economy embodies this new business model. Market-based mechanisms, with cooperation between government and private enterprises, are employed to achieve sustainable development goals, including restoration of degraded land and improvement in the provision of ecological services and products.

Climate change

China has committed to aiming to

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achieve carbon neutrality by 2060 and is setting a pathway to achieve it. China is already a leader in research, development, production and application of clean energy technologies. It is also exploring nature-based solutions to climate change.

Lessons Learned that Could Help Build a Shared Future for All Life on Earth

As the host of CBD COP15, China has expressed its determination to make commitments and contributions to global biodiversity conservation, and work with other countries to explore a successful paradigm for a harmonious relationship between human beings and nature. The lessons learned in China to date may be helpful in informing national and global efforts.

Redefine the relationship between humanity and nature

China has recognized that a systematic understanding of the relationship between human beings and nature, and a fundamental shift from viewing humans as isolated in a competitive world to seeing them as an integral part of an interconnected society and biosphere is needed.

The ancient Taoist idea of the UNM advocates for the intrinsic value of nature, upholding the belief that humanity is a component of nature and promoting respect for nature and the need to conform to its rules. The EC approach is more than just a pragmatic reliance on ecosystem service values, and instead places inherent value on nature. Other cultures have their own traditions that could be drawn upon to set a national philosophy that seeks the unity of humanity and nature. Such a reconsideration of the relationship between human beings and nature could help the international community to find better solutions regarding environmental challenges and economic development.

The relationship between the six principles of EC and the SDGs reflects the core concept of 'Harmony between Man and Nature', while EC is safeguarded by the strictest regulations and laws and joint efforts from international communities. 'Lucid waters and lush mountains are invaluable assets' is the development principle; 'no welfare more universally beneficial than a sound natural environment' is the awareness and action principle; while 'mountains, rivers, forests, fields, lakes and grasslands form a biotic community' is the governing principle.

[IMAGE: *WEI ET AL.*, NATL SCI REV, 2021, VOL. 8, NWAA279]

Implement with pilot projects and adaptive governance

Experiences in China prove that pilot projects are a good way to start. During the pilots and trials, priorities, objectives and technologies can be adapted to the various situations. Local, provincial and central governments can coordinate thoroughly on development of goals but different priorities and objectives could be set by different local governments to achieve them. Such evidence-based and highly adaptive governance has been found to be essential for the success of sustainability programs in China.

The planning and implementation process should take into account actual economic, political, ecological and legal feasibilities, as well as the needs of stakeholders at all levels. Timely evaluation and feedback should be incorporated to ensure necessary measures are taken to balance multiple planning objectives in the natural environment and economic society and to reveal and

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Starch synthesis from CO_2 successfully developed

Chinese scientists recently reported a *de novo* route for artificial starch synthesis from carbon dioxide (CO_2) for the first time. Research results were published in *Science* on September 24.

The new route makes it possible to shift the mode of starch production from traditional agricultural planting to industrial manufacturing, and opens up a new technical route for synthesizing complex molecules from CO_2.

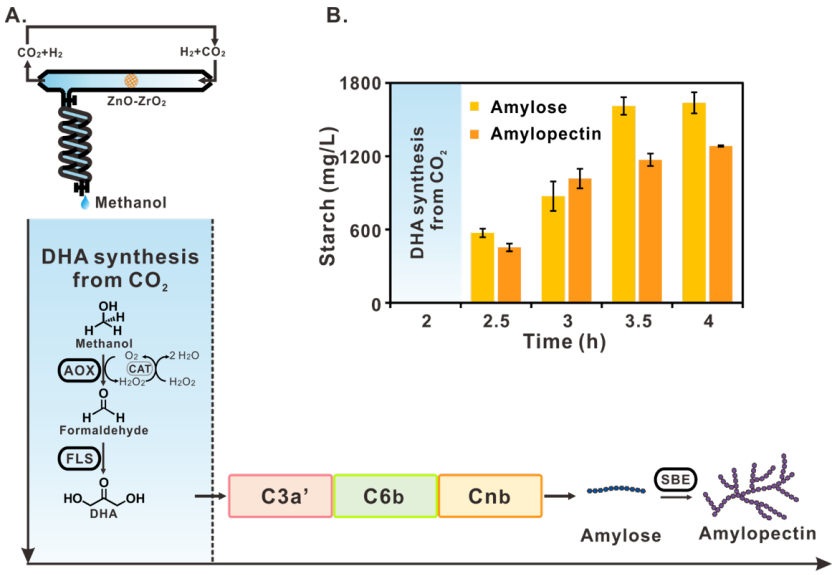
Starch is the major component of grain as well as an important industrial raw material. At present, it is mainly produced by crops such as maize by fixing CO_2 through photosynthesis. This process involves about 60 biochemical reactions as well as complex physiological regulation. The theoretical energy conversion efficiency of this process is only about two percent.

Strategies for the sustainable supply of starch and use of CO_2 are urgently needed to overcome major challenges of mankind, such as the food crisis and climate change. Designing novel routes other than plant photosynthesis for converting CO_2 to starch is an important and innovative S&T mission and will be a significant technology in today's world.

To address this issue, scientists at the Tianjin Institute of Industrial Biotechnology (TIB) of the Chinese Academy of Sciences (CAS) designed a chemoenzymatic system as well as an artificial starch anabolic route consisting of only 11 core reactions to convert CO_2 into starch.

This route was established by a "building block" strategy in which researchers integrated chemical and biological catalytic modules to utilize high-density energy and high-concentrations of CO_2 in a biotechnologically innovative way.

The researchers systematically optimized this hybrid system using spatial and temporal segregation by addressing issues such as substrate competition, product inhibition, and thermodynamic adaptation.



Starch synthesis via an artificial starch anabolic pathway (ASAP) from CO_2 [IMAGE: TIB]

The artificial route can produce starch from CO_2 with an efficiency 8.5-fold higher than starch biosynthesis in maize, suggesting a big step towards going beyond nature. It provides a new scientific basis for creating biological systems with unprecedented functions.

"According to the current technical parameters, the annual production of starch in a one-cubic-meter bioreactor theoretically equates with the starch annual yield from growing 1/3 hectare of maize without considering the energy input," said Cai Tao, lead author of the study.

This work would open a window for industrial manufacturing of starch from CO_2.

"If the overall cost of the process can be reduced to a level economically comparable with agricultural planting in the future, it is expected to save more than 90 percent of cultivated land and freshwater resources," said Ma Yanhe, corresponding author of the study.

In addition, it would also help to avoid the negative environmental impact of using pesticides and fertilizers, improve human food security, facilitate a carbon-neutral bioeconomy, and eventually promote the formation of a sustainable bio-based society.

TIB has focused on artificial starch biosynthesis and CO_2 utilization since 2015. To carry out such demand-oriented S&T research, it has gathered together all kinds of resources for innovation and integrated "discipline, task and platform" to achieve efficient coordination of research efforts.

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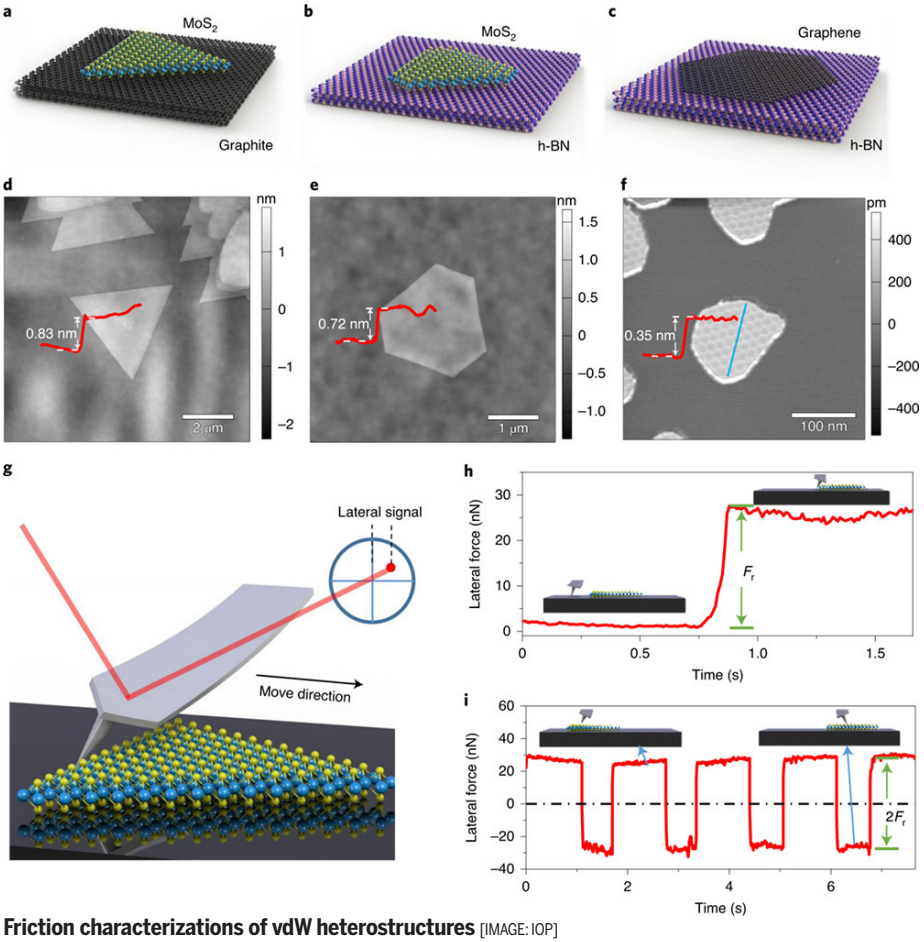
Source: Tianjin Institute of Industrial Biotechnology (TIB), Chinese Academy of Sciences

Discovery of an ideal superlubric system: large-lattice-mismatch van der Waals heterostructures

Abstract:

In a recent study, a team from the Institute of Physics (IOP) of the Chinese Academy of Sciences (CAS) discovered a new superlubric system, i.e., large lattice mismatched van der Waals heterostructures. A friction coefficient below 10^{-6} was observed in the system, the lowest achieved against all other materials so far. The interface superlubricity in large lattice mismatched van der Waals heterostructures shows no twist-angle dependence. Most importantly, in such a system the interface friction could fully vanish if the interface were perfect, as the measured friction in experimentally explored samples comes from structural defects such as domain edges and surface steps.



Friction characterizations of vdW heterostructures [IMAGE: IOP]

Nowadays, energy losses due to friction and wear account for approximately one-third of total human energy consumption. Achieving extremely low friction not only reduces energy consumption but also extends the life of machinery. Within this context, research on superlubricity has been a frontier in the area of tribology. Superlubricity is a regime of motion in which friction vanishes or very nearly vanishes. Generally, a superlubricant interface should have a coefficient of friction less than 10^{-3}. Superlubricity may occur when two crystalline surfaces slide over each other in dry incommensurate contact. This effect, also called structural lubricity, was suggested in 1991 and verified with great accuracy between two graphite surfaces in 2004.

It is worth noting that natural van der Waals materials such as graphite, molybdenum disulfide, and hexagonal boron nitride (hBN) have been used as solid-state lubricants for more than a hundred years. Due to weak van der Waals (vdW) forces between adjacent layers in such materials, they are a simple but good material platform to investigate superlubricity. In principle, an incommensurate van der Waals interface is an ideal system to study structural superlubricity.

In 2004, Joost W. M. Frenken's group at Leiden University reported pioneer work on measurements of extremely low friction between two graphite layers with a certain twisted angle (*PRL 2004, 92, 126101*), demonstrating a bench-mark progress on structural superlubricity. In 2008, Zheng Quanshui's group at Tsinghua University discovered a self-retraction effect originating from such extremely low friction in a similar interface (*PRL 2008, 100, 067205*).

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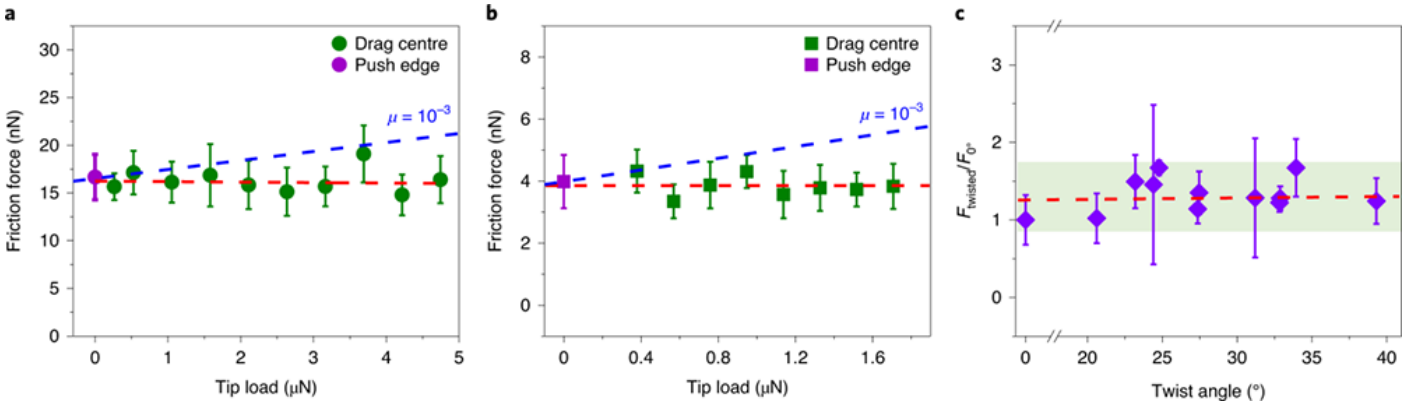

Superlubricity of MoS_2/graphite and MoS_2/h-BN heterointerfaces [IMAGE: IOP]

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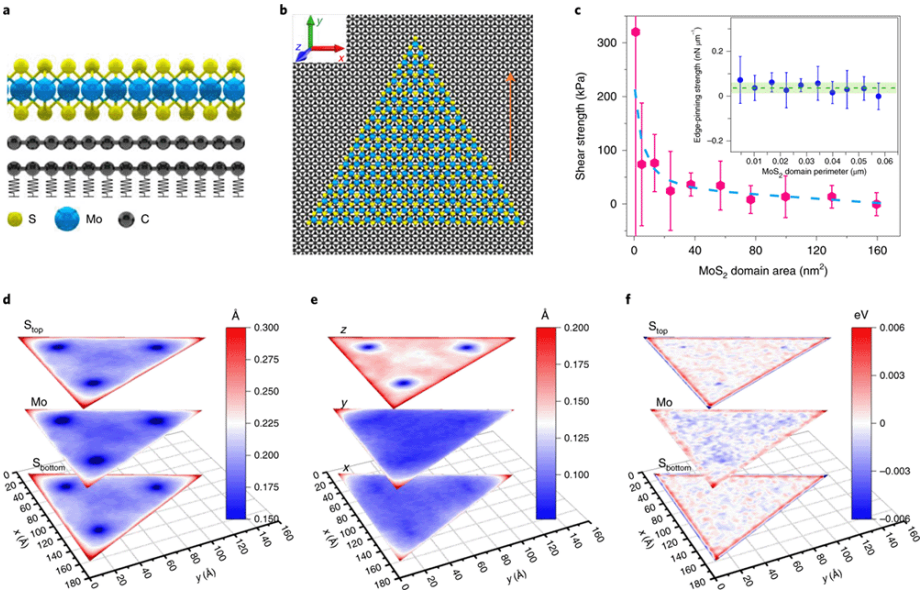
In such homogeneous vdW interfaces, commensurate contact arises when the twist angle is zero, leading to maximum friction, and small twist-angle contacts generate Moiré patterns; however, local commensurate contacts within each Moiré supercell still exist, leading to a rather large friction, whereas large twist-angle contacts are approximately incommensurate, which leads to a very small friction.

A possible solution to eliminate the twist-angle dependence of friction in such vdW homointerfaces is to employ vdW heterointerfaces. In 2016, Zhang Guangyu's group at the Institute of Physics (IOP) of the Chinese Academy of Sciences (CAS) studied the thermal stability of graphene-hBN heterointerfaces and found an interesting dynamic phenomenon: thermally induced rotation of graphene on hBN (*PRL 2016, 116, 126101*). Such rotations finally drive the heterointerface to a configuration with twist angle close to 0° or 30°, revealing the possible existence of structural superlubricity at this van der Waals heterogeneous interface at non-stable twist-angles.

Indeed, in 2018 Zheng's group measured the friction of such heterointerfaces and verified the structural superlubricity phenomenon. They also found that the anisotropy of friction observed in the heterojunction was significantly lower than that measured in the homointerfaces (*Nature Materials 2018, 17, 894*). Due to the rather small lattice mismatch of ~1.7 percent between graphene and hBN, these graphene-hBN heterointerfaces still suffer from pinning effects at small twist angles due to the presence of Moiré superlattices. It remains challenging to reveal a stable and isotropic structural superlubricity at such vdW interfaces.



MD simulations of MoS_2 flakes sliding on graphite [IMAGE: IOP]

Recently, Zhang's group has investigated systematically the superlubricity phenomenon in large lattice mismatched vdW heterointerfaces. Two typical interfaces were addressed, i.e., MoS_2/graphite and MoS_2/hBN with lattice mismatch of ~26.8 percent and ~24.6 percent, respectively. In order to measure the interface friction precisely, they set up an environment-controllable atomic force microscope (AFM) system and developed relative lateral force measurement techniques for AFM.

To their surprise, they found isotropic ultra-low friction coefficients all below 10^{-6} under any twist-angles in these vdW heterostructures. Such low friction coefficients of below 10^{-6} are lower than ever achieved in previous research.

In order to reveal the features of such superlubricity in these large-lattice-mismatched vdW heterointerfaces, they also performed further size dependent measurements. Results indicate that the friction forces during sliding a domain

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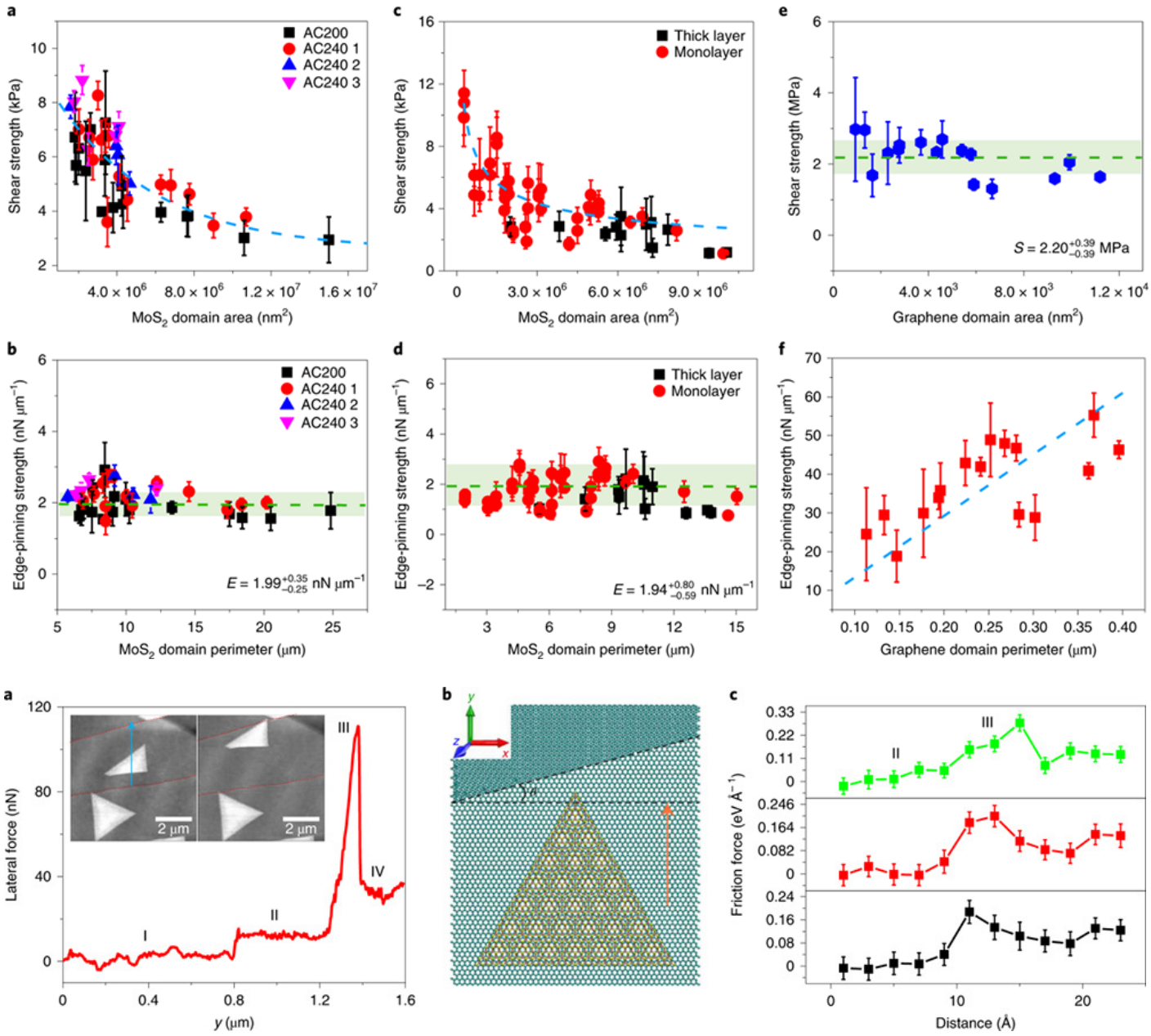

Above: Origin of friction for three different heterointerfaces [IMAGE: IOP] **Below: Effect of interface steps on the friction force** [IMAGE: IOP]

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of monolayer MoS_2 on graphite or hBN come dominantly from the MoS_2-domain-edge pinning effect, while they totally vanish within the plane of the domain. Despite the domain edge, the group also investigated the surface steps on graphite or hBN and found a similar pinning effect. Collaborating with Tomas Polcar' group at Czech Technical University, they also carried out molecular dynamic (MD) simulations on this domain-edge pinning effect. They found that the dynamics of the edge atoms present peculiar traits for distortions and potential energy fluctuations, leading to a significant contribution to the friction force which is consistent with the experimental results.

This study has explored in depth the isotropic superlubricity in a class of new vdW heterointerfaces with large lattice mismatches. The message obtained from this research will be helpful in designing and applying advanced superlubric interfaces. The work, entitled "Ultra-low friction and edge-pinning effect in large-lattice-mismatch van der Waals heterostructures", was recently published in *Nature Materials 2021*.

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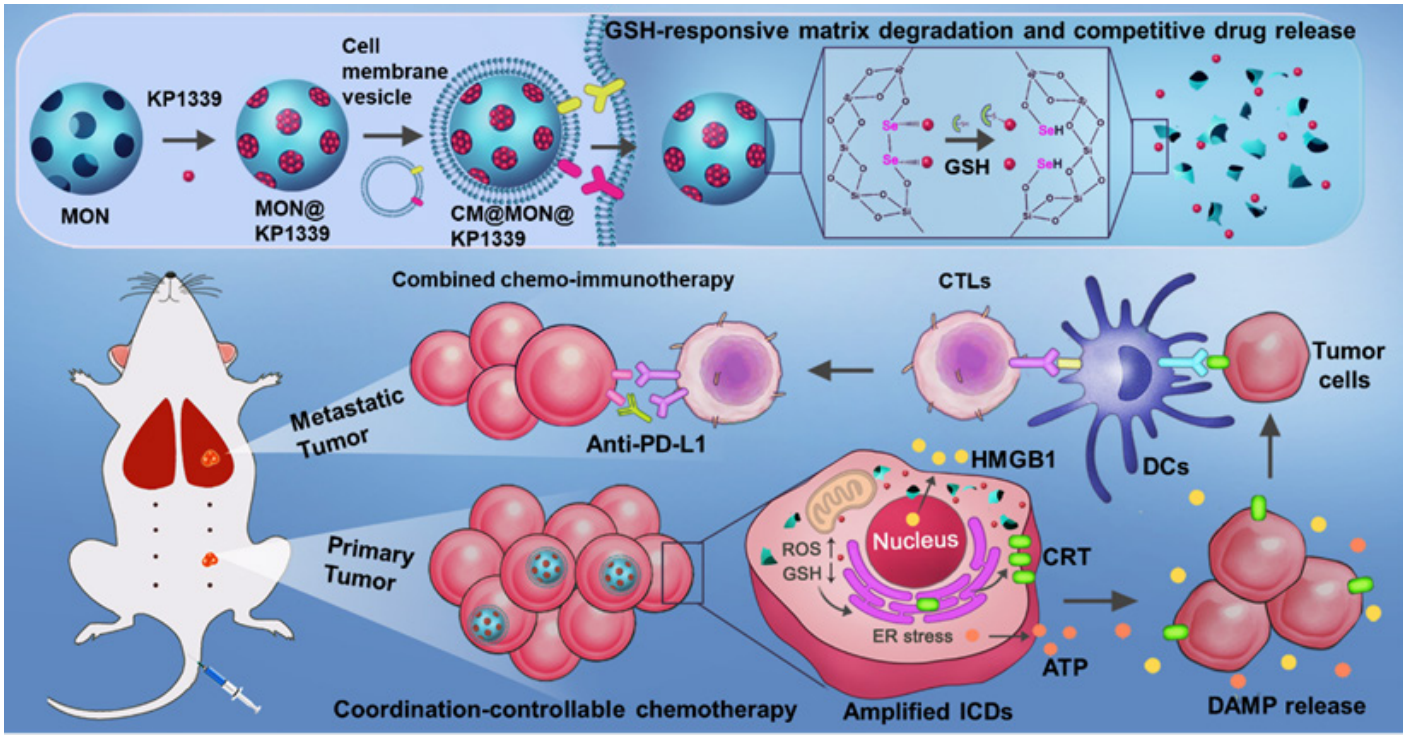
Source: Institute of Physics (IOP), Chinese Academy of Sciences



Schematic of synthesis of diselenide-bridged MONs for coordination-responsive drug release and amplified ICD for efficient and safe cancer chemoimmunotherapy [IMAGE: SIBET]

Intelligent biodegradable biomaterial for breast cancer treatment developed

Cancer chemoimmunotherapy has enjoyed significant clinical progress in recent years. Immunogenic cell death (ICD) is a particular form of cell death induced by various cancer therapeutics which elicit innate and adaptive immune responses. Although chemoimmunotherapy benefits treatment for solid tumors and inhibits distant metastases, several studies have reported that anti-cancer drugs alone fail to promote sufficient ICD or elicit strong antitumor immunological responses. Further amplifying the chemotherapy-driven ICD in a natural or/and artificial manner is urgently warranted. Amplification of chemotherapy-driven ICD has been achieved through nanoparticulate carriers with tumor targeting and controlled-drug release capable of responding to external or internal stimuli.

Mesoporous organosilica nanoparticles (MONs) are excellent candidates for clinical application because of their tunable chemical structure and large surface area with controllable matrix degradation and responsive drug release. One of the scientific research challenges to be solved in cancer therapy is designing intelligent MONs that can be degraded for controlled drug release in response to tumor microenvironment characteristics, such as acidity, hypoxia, and high redox.

Recently, a research team led by Professor Dong Wenfei from the Suzhou Institute of Biomedical Engineering and Technology (SIBET), in collaboration with Professor Shao Dan from the South China University of Technology and Professor Sun Wen from the Dalian University of Technology, developed a coordination-responsive diselenide-bridged MON loaded with the ruthenium compound (KP1339) for breast cancer chemoimmunotherapy.

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KP1339-loaded MONs show a glutathione (GSH)-stimulated coordination and redox dual-responsive drug release profile while inducing intracellular GSH depletion and ROS production in breast cancer cells. Notably, a high concentration of diselenide-bridged MON specifically evoked oxidative and ER stress to induce and amplify ICD. The cancer cell membrane coating strategy promoted the MON@KP1339-amplified ICD and boosted robust antitumor immunity, demonstrating better regression of both primary and distant tumors as well as metastasis inhibition in combination with a PD-L1 immune checkpoint inhibitor.

This study suggests that the design of biomimetic diselenide-bridged MON-based potential ICD nanoamplifier with a possibility of coordination and redox dual-responsive drug release and amplified ICD would advance efficient and safe cancer chemoimmunotherapy.

The research article "Coordination and Redox Dual-Responsive Mesoporous Organosilica Nanoparticles Amplify Immunogenic Cell Death for Cancer Chemoimmunotherapy" was recently published in *Small*.

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Source: Suzhou Institute of Biomedical Engineering and Technology (SIBET), Chinese Academy of Sciences

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mitigate shortcomings. Furthermore, a comprehensive monitoring system should be established and multi-source data from different fields should be integrated to minimize uncertainties and aid decision-making with the best available empirical evidence. China has also found that both strict supervision and enforcement at the national level are recommended to improve governance and to achieve goals.

Strengthen information exchange and cooperation

China's experience with EC is an example of how a concerted national effort to mainstream environmental policy with a culturally appropriate philosophy and leadership from the top levels of government can help to realize objectives of environmental improvement under the Rio Conventions and the SDGs.

Building the community of the future with common goals for humankind will require extensive sharing of information on best practices, sustainable innovation, problem-solving techniques and traditional wisdom; with that sharing each community will draw on the strength of the others and all may thrive and prosper in a nature-rich future. Enhanced inter-community exchanges and cooperation, coupled with mutual respect for differences, will be important in crafting appropriate solutions that meet shared global goals.

Future Research and Conclusion

Serving as agents for transformative change, the concept and actions of EC in China provide important insights for the international community to consider when meeting these unprecedented challenges. Further research is needed regarding market-oriented eco-compensation mechanisms, consumer support for the products of EC-oriented enterprises, social engagement strategies that cultivate awareness and participation in EC, and the synergies between different goals or targets like biodiversity conservation, climate change, desertification and SDGs.

CBD COP15 provides a good opportunity for discussion of the potential for developing a global eco-civilization appropriate for the diverse cultures of the world. There might be chances for scholars, practitioners and policy-makers worldwide to understand the Chinese experience with EC and generate broader global applications, especially for those countries with very different governance arrangements. China wishes to promote collaboration among international communities and engage in information exchange and sharing of lessons learned with other countries in an atmosphere of mutual respect. China's experiences can stimulate a global conversation about how best to achieve the SDGs and the goal of living in harmony with nature in a manner appropriate to differing national contexts. Such an approach could contribute to the development of a robust new GBF designed to build a shared future for all life on Earth.

Source: Wei et al, Natl Sci Rev, 2021, Vol. 8, nwaa279
Chinese Academy of Sciences

Chinese scientists share experience of biodiversity conservation with Latin American countries

International cooperation is necessary for data sharing as is transfer of technology and capacity building of science and technology in developing countries, agreed the representatives of countries participating in the Roundtable on Knowledge, Innovation and Benefit Sharing at the 15th Meeting of the Conference of the Parties to the Convention on Biological Diversity, on October 13.

The participants said knowledge and innovation provide strong technological support for conservation and sustainable use of biodiversity. To achieve the goals of the Convention on Biological Diversity and its protocols, there is an urgent need to promote cooperation in technological development and innovation related to biodiversity conservation.

Chinese and Latin American scientists have carried out cooperation and exchanges in biodiversity conservation for many years.

Rivas, a teacher in the Department of Biological Sciences at the National University of San Marcos in Peru, for example, came to Guangzhou in September 2019, where she used the molecular data research method to complete experiments for her doctoral dissertation under the guidance of Ge Xuejun, research fellow at the South China Botanical Garden (SCBG) of the Chinese Academy of Sciences (CAS).

"It hasn't been long since the molecular data research method was applied to botanical research. However, in China, large-scale molecular data is already being used at the genome level," she said.

Eight years ago, Rivas participated in an international training course on biodiversity conservation and management organized by CAS's SCBG, benefiting a lot from the experience of learning from so many experts. When she encountered difficulties writing her doctoral dissertation, the first thing she thought of was to return to China to tackle the problem.

"China has advanced technology in the use of molecular means to analyze the genetic structure of plants. We hope to formulate protection strategies for different species through gene sequencing methods and to provide help in biodiversity conservation for Latin American countries," Ge said.

In December 2008, scientists from CAS's SCBG went to Peru for a biodiversity survey and signed a cooperation agreement with La Molina National University of Agriculture. The researchers inspected the vegetation in the Amazon tropical rain forest and the middle section of the Andes, covering a distance of more than 1,500 kilometers.

Researchers from the South China Botanical Garden (SCBG) of the Chinese Academy of Sciences on a field trip in Ecuador and Colombia in September 2019 [IAMGE: SCBG]

Ren Hai, director of CAS's SCBG, said this was the first time that Chinese botanists had conducted a systematic survey of plant resources of the Amazon River Basin in Peru. Over the past decade, China and Peru have carried out joint scientific expeditions several times and discovered some new species, which boosted the scientific research of both countries.

In 2015, the SCBG and the National University of San Marcos jointly established a molecular system and evolution lab in Peru.

"This joint laboratory is bearing fruit and providing a lot of support for Peruvian researchers," Rivas said.

We will establish a Chile-centered comprehensive international cooperation center to increase cooperation with Latin American countries, said Ren. Systematic studies on the Andes Mountains and the Qinghai-Tibet Plateau will be conducted, exploring the issues such as plant diversity protection, climate change, and sustainable development.

"We hope more plant conservationists and regulators from developing countries, especially countries along the Belt and Road, will come to China, and we would like to share our knowledge and experience and work together for the conservation of biodiversity," Ren said.

Source: Xinhua

[IMAGES: PEOPLE'S DAILY]

South African botanist working in Kunming: If I hadn't come to Yunnan, I would not have achieved such fruitful research results

"If I hadn't been to Yunnan Province, I would not have achieved such fruitful research results," said Peter Mortimer, a South African research fellow at the Kunming Institute of Botany (KIB) of the Chinese Academy of Sciences (CAS), in an interview.

Mortimer came to Kunming City in Southwest China's Yunnan Province on a graduation trip 11 years ago, and fell in love with this city at first sight.

Making his decision to stay and work at CAS's KIB, he did not expect that he would become a botanical expert with support from his research team in ten years.

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Devoted to fungus research, he and his team have discovered more than 1,000 new fungi over that period of time. They have been recording all the edible mushrooms in the world and studying the artificial cultivation of those with ultra-high economic value.

Currently, Mortimer is in charge of four projects funded by the National Natural Science Foundation of China (NSFC). In 2020, he received the special support for high-end foreign experts in the Yunnan Province Program for High-level Talents Introduction.

He attributes all his achievements to the rich biodiversity resources in China and the country's tremendous efforts to protect biodiversity over recent years.

"In the past five years, China has put increasing effort into diversity conservation, with more and more international cooperation projects having been carried out, which provides me with opportunities to participate in cooperation projects with Thailand, South Africa, and Kenya," Peter said.

"China's achievements in ecological protection stand out. With the opening of the COP15 held in Kunming, I hope China will play a leading role in global biodiversity conservation in the future," he added.

Source: People's Daily

Xu Yigang elected AGU Fellow

Professor Xu Yigang from the Guangzhou Institute of Geochemistry (GIG) of the Chinese Academy of Sciences (CAS) was elected as a Fellow of the American Geophysical Union (AGU), as the organization announced its 2021 class of Fellows on September 28.

Recognized by the AGU fellowship for his breakthroughs in igneous petrology and geochemistry, Professor Xu has made remarkable and lasting contributions to mantle dynamics and magma genesis. His work has influenced a wide range of fields in geosciences, such as geology, geochemistry, petrology, tectonics, seismology, and mass extinction by global climate change.

Founded in 1919, AGU is one of the world's most influential academic organizations in the Earth and space sciences, boasting more than 60,000 members from 148 countries and regions. Since 1962, the organization has chosen fewer than 0.1 percent of its members to become Fellows as a way to celebrate their outstanding achievements and contributions by pushing the frontiers of science forward. This year's honors went to 59 individuals, two of whom work in institutions on the Chinese mainland.

Source: Guangzhou Institute of Geochemistry, Chinese Academy of Sciences

Xu Yigang works in the field. [IMAGE: XU YIGANG]

Chang'e-5 mission sheds light on evolution of the moon

Chinese scientists have offered new insights into the thermal and chemical evolution of the moon after studying samples from the Chang'e-5 lunar sample return mission.

These samples of volcanic rock, which is a type of basalt, are the youngest lunar samples to be directly dated at around 2 billion years old. Analysis of these basalts reveals how the composition and water content of the moon changed over time, which may help us to understand the geological and geochemical evolution of the moon.

Their results were presented in three papers that were published in *Nature* on October 19.

Source: Institute of Geology and Geophysics, Chinese Academy of Sciences