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72 Years of Excellence — Chinese Academy of Sciences

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CAS holds basic research work conference

The Chinese Academy of Sciences (CAS) held a conference on November 5 to deploy and arrange its basic research work for upcoming periods.

Based on fundamental requirements, CAS has clarified the strategic positioning, key layout and development goals of its basic research work, and has put forward a series of targeted and operable policy measures in terms of research topic selection, the organizational model, research support, talent deployment, the evaluation system, and international cooperation.

The conference also highlighted the construction of styles of study and work, as well as academic ecology.

Source: Chinese Academy of Sciences

International student workshop held virtually for academic exchanges

Graduate students and mentor representatives from China, Japan, and the United States attended an international student workshop held virtually from November 9 to 11, when they participated in various online activities concerning scientific research academic reports, poster exhibits, interactive games and cultural experience events.

The students are from the Institute of Genetics and Development Biology (IGDB), Chinese Academy of Sciences (CAS), China, NARA Institute of Science and Technology (NAIST), Japan, and the UC Davis, the United States.

They enjoyed a strong academic exchange atmosphere through different activities at the workshop.

The participating students put great effort into preparing their academic reports and research posters, and shared their scientific research progress and experience with each other.

The workshop's organizing committee and mentors and students from the United States and Japan were impressed by the scientific research progress made by Chinese graduate students, and spoke highly of their communication abilities and innovative thinking.

A variety of ice-breaker activities were also held during the event to help students from different countries quickly get to know each other. The virtual meeting soon warmed up through an interactive game to distinguish science and technology achievements.

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CAS achievements and scientists win National Science and Technology Awards

It was announced at the National Science and Technology Awards Conference held at the Great Hall of the People in Beijing on November 3 that 25 achievements and scientists of the Chinese Academy of Sciences (CAS) won 2020 National Science and Technology Awards.

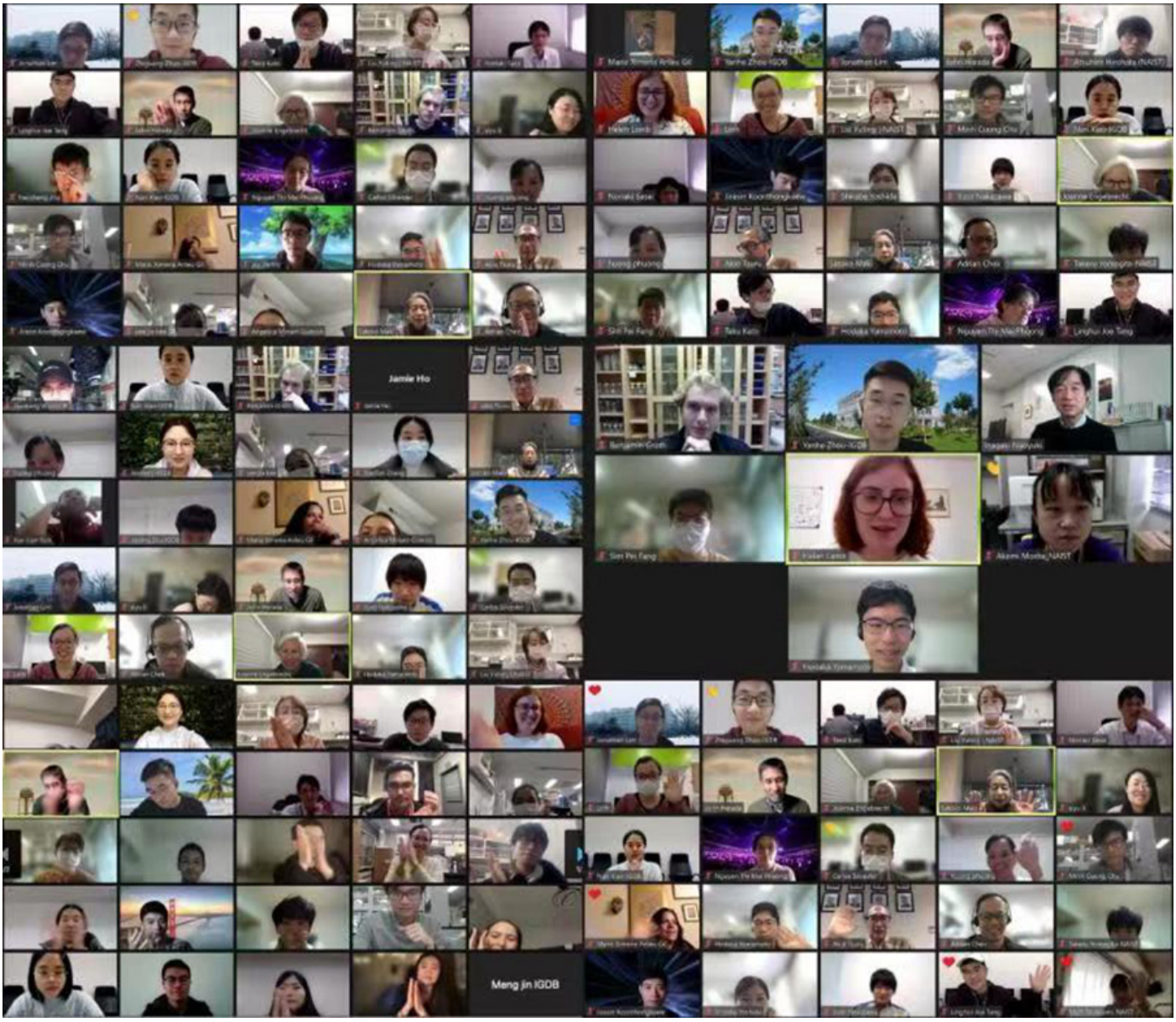
In the State Natural Science Awards, CAS, the first accomplishment unit, won first prize of the 2020 State Natural Science Awards for the scientific accomplishment of "Nano-confined Catalysis" led by academician Bao Xinhe of CAS's Dalian Institute of Chemical Physics (DICP), while 14 other achievements won second prizes.

The special project achievement of CAS's Aerospace Information Research Institute was awarded first prize at the State Technology Invention Awards, and five achievements were awarded second prizes.

Three achievements were awarded the second prize of the State Scientific and Technological Progress Award.

Professor Richard G. Strom of the Netherlands Institute for Radio Astronomy, a long-term collaborator with CAS's National Astronomical Observatories (NAOC), won the International Science and Technology Cooperation Award.

Source: Chinese Academy of Sciences



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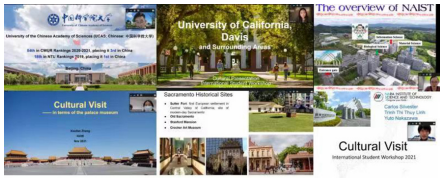
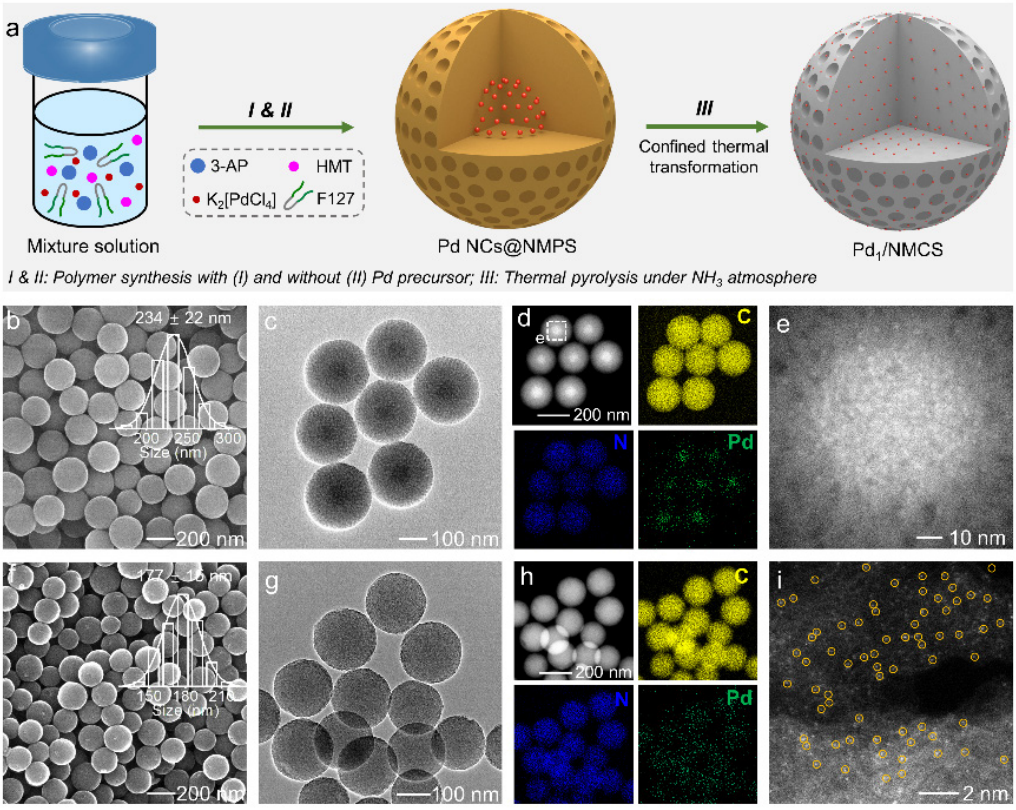
At a cultural exchange session that took place on November 11, students from three countries introduced the colorful campus culture of UC Davis, local customs along the west coast of the United States; the NAIST and beautiful local scenery and delicacies in Nara; and the profound scientific research foundation and beautiful campus scenery of CAS and the University of Chinese Academy of Sciences, as well as the ancient and mysterious Forbidden City in Beijing through virtual participation.

The three-day event provided students from different countries with excellent opportunities to conduct academic exchanges, broaden their horizons, make new friends, and increase their confidence in using English to communicate.

Despite the inconveniences caused by the COVID-19 pandemic, the participating students and mentors made the workshop a successful exchange platform through active participation.

Source: Institute of Genetics and Developmental Biology (IGDB), Chinese Academy of Sciences





Synthesis and characterization of Pd_1/NMCS using thermal transformation strategy [IMAGE: TIAN ZHENGBIN]

Mesoporous structure enhances catalytic performance of single-atom catalysts

Carbon-supported single-atom catalysts (SACs) are promising in heterogeneous catalysis due to their high atomic utilization efficiency and unique catalytic performances.

However, maximum utilization of the carbon-supported single atoms is very challenging, since many single atoms are probably embedded in the carbon matrix and thus not available during catalysis due to the mass transfer limitation.

Recently, researchers from the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT) of the Chinese Academy of Sciences (CAS) have developed a confined thermal transformation strategy to synthesize nitrogen-doped mesoporous carbon nanospheres (NMCS)-supported SACs.

The study was published in *Journal of Materials Chemistry A* on October 22.

In this study, the researchers reported a soft-templating method to synthesize the core-shell mesostructured polymer nanospheres with metal nanoclusters (M-NCs, M=Pd, Pt) as the core, which can be easily converted into the NMCS-supported SACs (M_1/NMCS) after a confined thermal transformation process.

"The thermal transformation process happens in the NMCS, and the loss of metal is avoided to a great extent," said Professor Wang Guanghui, the senior author of the study.

By this strategy, Pd_1/NMCS and Pt_1/NMCS were prepared with rich porosity and high N content. The synthesized Pd_1/NMCS sample showed enhanced catalytic performance in the selective hydrogenation of quinoline compared with Pd_1/NCS without mesopores.

"The enhanced activity indicates to some extent that the mesoporous structure of Pd_1/NMCS is indeed beneficial for the exposure of active sites and the mass transfer," said Professor Wang.

This work supplies a way to prepare single atom catalysts supported on the nitrogen-doped mesoporous carbon nanospheres, which has potential applications in various reactions.

(Text by Tian Zhengbin)

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Chinese Academy of Sciences

Source: Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences

Indispensable role of HDAC6 in human innate resistance against tuberculosis revealed

Tuberculosis (TB), a contagious disease caused by *Mycobacterium tuberculosis* (Mtb), remains a major cause of morbidity and mortality worldwide. Dr. Liu Cuihua's group has been investigating the molecular mechanisms underlying Mtb-host interplays, and previous studies from her group have provided potential targets for the development of anti-TB treatments based on pathogen-host interacting interfaces (*Autophagy*, 2021; *EMBO Report*, 2021; *Nature Communications*, 2019; *Nature Communications*, 2017; *Nature Immunology*, 2015).

Increasing lines of evidence indicate that some individuals, termed resisters, are naturally resistant to TB infection. The resister phenotype has been linked to efficient host innate immune responses, but the underlying mechanisms and the key immune factors remain poorly understood. Recently, Dr. Liu's group, in collaboration with Dr. Yu Pang's group from Beijing Chest Hospital, found that histone deacetylase 6 (HDAC6) is persistently expressed in monocyte-derived macrophages from resisters during Mtb infection. They further showed that HDAC6 acts as a key host factor required for macrophage production by pro-inflammatory cytokines including TNF-α, IL-1β and IL-6, and acidification of Mtb-containing vacuoles for bacterial clearance. Taken together, this study's results reveal an indispensable role of HDAC6 in mediating anti-Mtb innate immune responses in resisters, and imply that HDAC6 may serve as a marker for individual TB risk as well as a novel host-directed anti-TB therapeutic target.

The paper, entitled "HDAC6 contributes to human resistance against *Mycobacterium tuberculosis* infection via mediating innate immune responses", has been published online in *The FASEB Journal* with Zhang Fuzhen, Yu Shanshan, Chai Qiyao and Wang Jing as the co-first authors and Dr. Liu and Dr. Yu as the co-corresponding authors.

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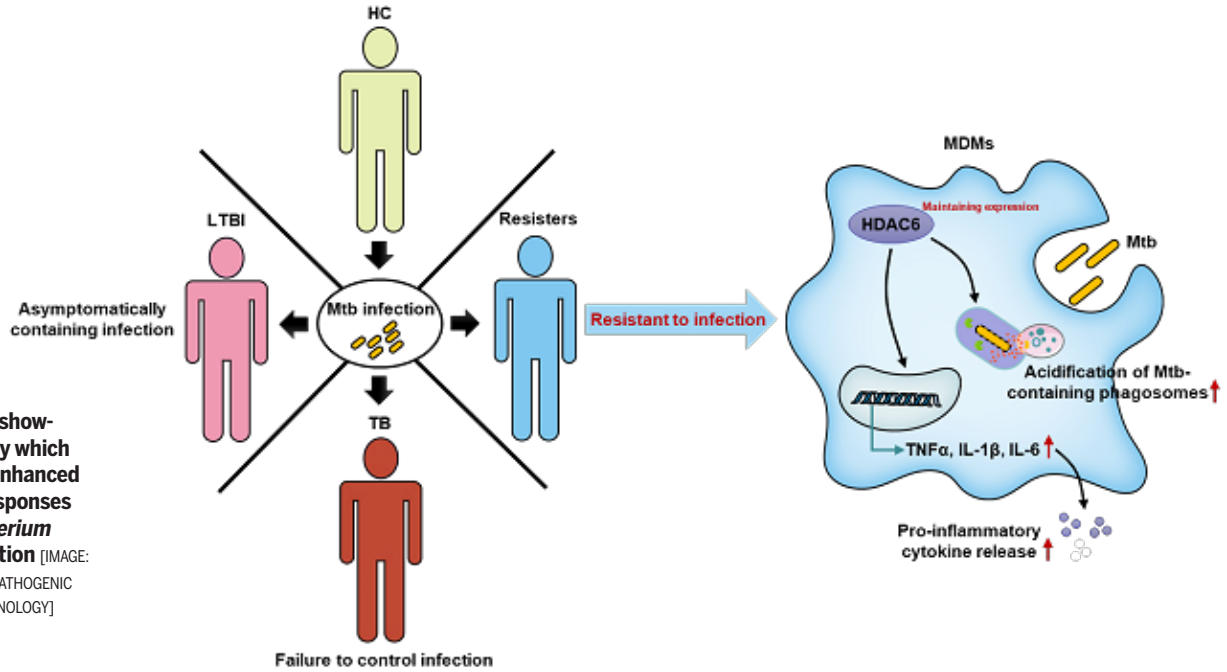
Chinese Academy of Sciences

Source: CAS Key Laboratory of Pathogenic Microbiology and Immunology, Institute of Microbiology, Chinese Academy of Sciences



Schematic model showing mechanisms by which resisters display enhanced innate immune responses against *Mycobacterium tuberculosis* infection [IMAGE: CAS KEY LABORATORY OF PATHOGENIC MICROBIOLOGY AND IMMUNOLOGY]

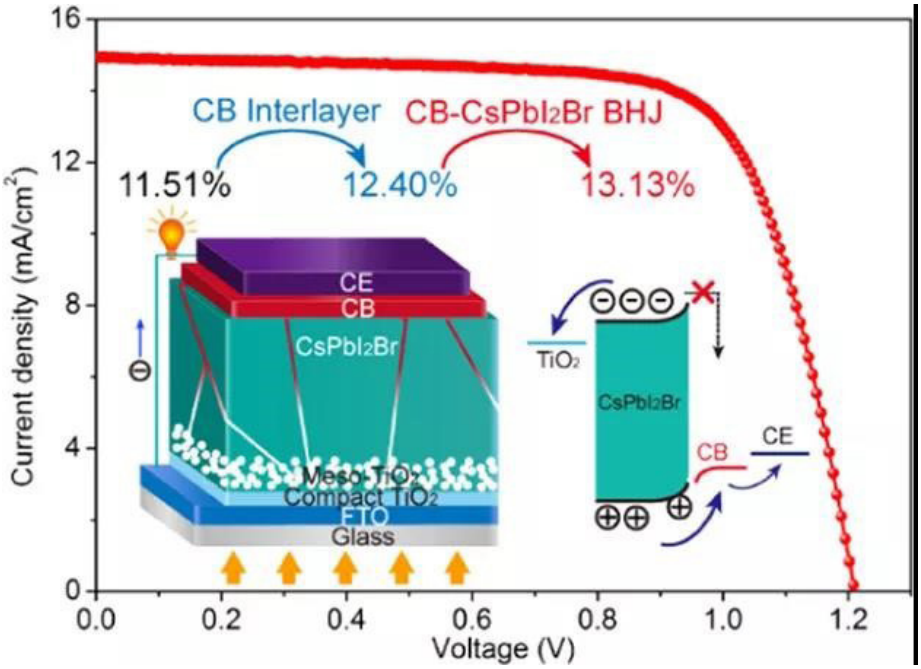
Interface modification improves the performance of perovskite solar cells based on carbon electrodes

Solar cells can realize efficient conversion of solar energy to electric energy without environmental pollution and carbon emissions. Highly efficient solar cells will help to reach peak carbon emissions and achieve carbon neutrality.

Perovskite solar cells feature high efficiency, high defect tolerance, solution processes and low cost. They exhibit excellent performance in both single-junction and multi-junction solar cells. Noble metal electrodes inhibit reduction of the device cost, while the carbon electrodes of perovskite cells have the merits of low cost, simple preparation methods and high stability. Fully printable perovskite modules based on carbon electrodes with an area of >70 cm^2 have achieved an efficiency of more than 13 percent so far, and show excellent stability.

However, there are insufficient interfacial points of contact and severe energy mismatches in perovskite/carbon electrode interfaces. In addition, the thermal treatment process of printed carbon electrodes can cause damage to the perovskite film beneath the carbon electrodes.

Recently, a research team led by Professor Yang Songwang of the Shanghai Institute of Ceramics (SIC), Chinese Academy of Sciences (CAS), has made progress in creating perovskite solar cells based on printed carbon electrodes. In order to improve the poor contact points in the carbon electrode/$CsPbI_2Br$ perovskite interface and energy level mismatches, they introduced carbon black nanoparticles to construct a carbon black interlayer and optimize the extraction of carriers.



Carbon black interlayer improves the efficiency of all-inorganic perovskite solar cells based on carbon electrodes [IMAGE: SIC/CAS]

The work function of the carbon black interlayer (-5.10 eV) is located between the valence band maximum of the $CsPbI_2Br$ perovskite (-5.44 eV) and the work function of the carbon electrode (-5.03 eV), which can reduce the interface energy mismatch.

The carbon black interlayer is also dense and uniform, which contributes to sufficiency of interfacial contact between the $CsPbI_2Br$ perovskite layer and the carbon electrode. The above advantages ensure an effective extraction of photogenerated holes, and the efficiency of the optimal device reaches 13.13 percent.

Moreover, the device based on the carbon black interlayer maintains about 90 percent of its initial efficiency after being continuously heated at 85°C for 2,000 hours, showing good thermal stability of $CsPbI_2Br$ solar cells based on carbon electrodes.

Furthermore, in order to further enhance the efficiency of carbon-based solar cells, the team introduced an inorganic CuSCN hole transporting layer between the $(CsFAMA)Pb(IBr)_3$ perovskite and the carbon electrode to improve the hole extraction and device efficiency. They demonstrated that the heating process of the carbon electrode

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under high temperature (~100°C) causes the diffusion of SCN^- into the perovskite layer and therefore reduces the performance of the device.

To solve this problem, they developed a vacuum-assisted drying process for the preparation of carbon electrodes. This process can accelerate solvent volatilization at a lower temperature (<60°C), which inhibits SCN^- diffusion caused by the heating process and improves the efficiency of the device to 15.72 percent.

Furthermore, the stability test showed that the device still maintained about 85 percent of its initial efficiency after 300 hours of continuous light soaking or 1,000 hours of storage (unencapsulated), indicating good stability.

The above results were published in *ACS Applied Materials & Interfaces* in articles entitled "$CsPbI_2Br$ Perovskite Solar Cells Based on Carbon Black-Containing Counter Electrodes" and "Vacuum-Assisted Drying Process for Screen-Printable Carbon Electrodes of Perovskite Solar Cells with Enhanced Performance Based on Cuprous Thiocyanate as a Hole Transporting Layer".

In addition, Professor Yang's team has developed large-area perovskite sub-modules (125 mm × 125 mm) based on the carbon electrodes. They have built a field test system to evaluate the outdoor performance of the perovskite sub-modules and also established a small-scale distributed electricity generation system based on the perovskite modules to evaluate their practical running properties.

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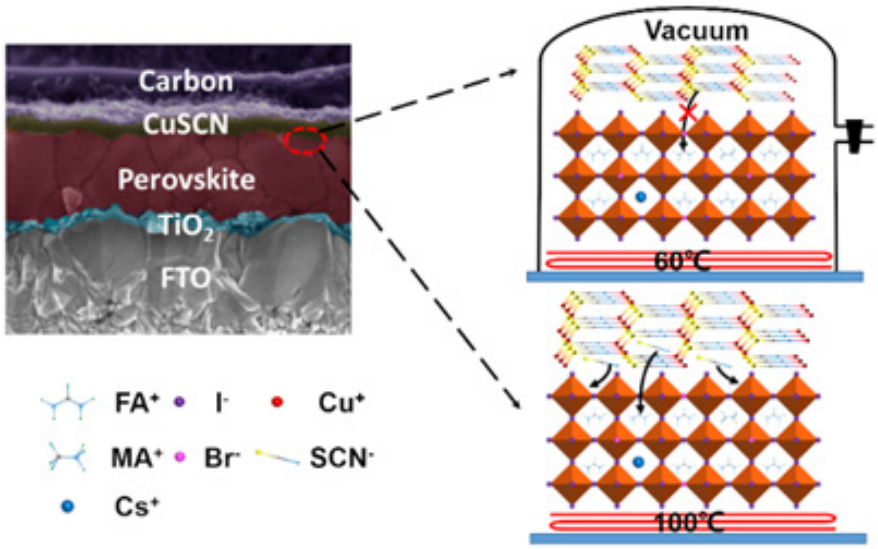
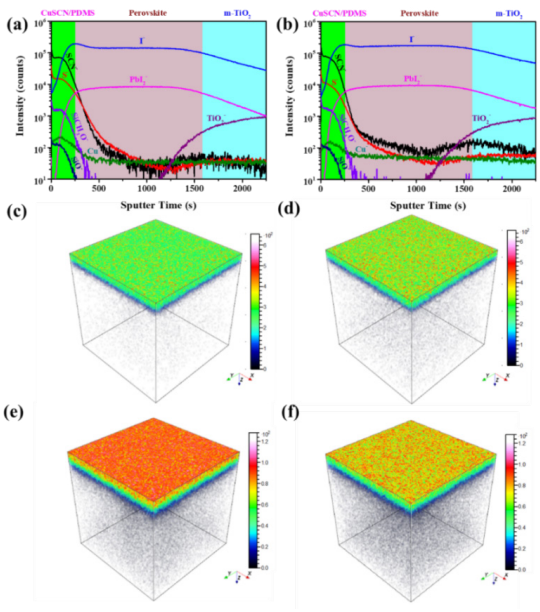
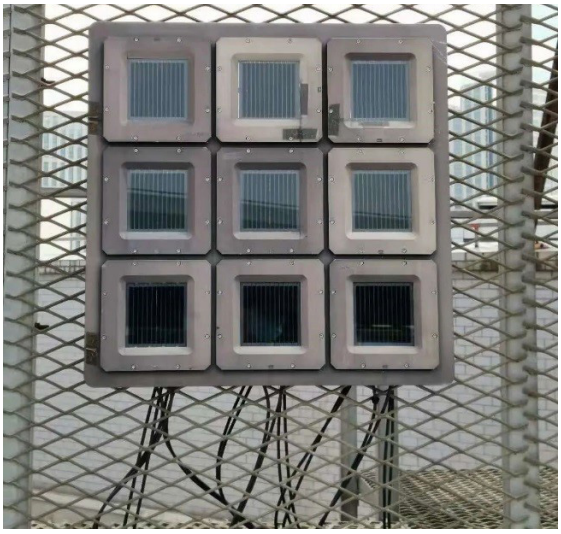
Source: Shanghai Institute of Ceramics (SIC), Chinese Academy of Sciences





Schematic diagram of the vacuum-assisted drying process of carbon electrodes and the ToF-SIMS element depth distribution of perovskite/CuSCN films
[IMAGE: SIC/CAS]



Field test system for perovskite sub-modules
[IMAGE: SIC/CAS]

CAS holds virtual Belt and Road environmental health seminar

A Belt and Road environmental health seminar was held virtually on November 3, with officials and experts from the Bureau of International Cooperation of the Chinese Academy of Sciences (CAS), the Consulate General of the Republic of Ecuador in Guangzhou, and CAS's Institute of Urban Environment, attending and delivering speeches at the meeting.

The sponsors of the meeting are CAS's Institute of Urban Environment, the Belt and Road Alliance of Urban Environmental Health under the Alliance of International Science Organizations (ANSO), and the Fujian Belt and Road Environmental Health Joint Laboratory.

Experts and scholars from the Agency of the Regulation and Control of Biosecurity and Quarantine for Galapagos, the Industrial University of Santander in Colombia, the National University of Tumbes in Peru, the Technical University of Manabí in Ecuador, and CAS's Institute of Urban Environment made reports at the meeting.

Participants also discussed the progress, problems, solutions and plans of the construction and application of the species pollutant load database in the Belt and Road region, which is an international partnership program of CAS.

Scholars from Ecuador, Colombia, Peru, and China attended the meeting.

Source: Institute of Urban Environment (IUE), Chinese Academy of Sciences

British biologist's engagement in China's biodiversity conservation

In the words of Richard Corlett, a world-renowned British conservation biologist, it was China's sincere commitment to biodiversity conservation that brought him to Southwest China's Yunnan Province in July 2012.

Before then, Corlett had studied tropical plants for over three decades in Southeast Asia. After receiving an invitation from the Xishuangbanna Tropical Botanical Garden (XTBG) of the Chinese Academy of Sciences (CAS), he happily packed his bags and embarked on a new research journey.

"It's a wonderful place," Corlett said of XTBG. "It's this combination of a botanical garden… (and a place of) cutting-edge research where we compete with the rest of the world, where you have exciting findings every day."

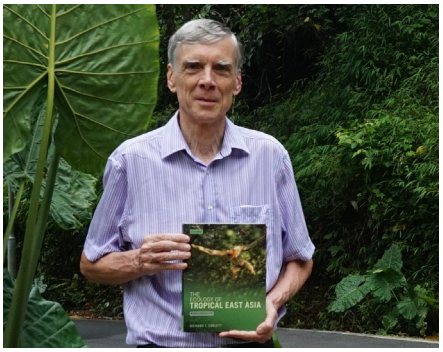
Established in 1959, the garden is both a treasure house of biodiversity and a leading research center. It boasts over 13,000 species of plants, including a large tropical forest, covering an area of 1,125 hectares in total. Scientists working here have stunned their counterparts worldwide on multiple occasions with outstanding academic results.

The 70-year-old biologist first visited XTBG 30 years ago, when a lack of funds was hindering the development of research institutions in the country, he recalled. Today, it is a magnet for global talent in relevant research fields, with over 110 scholars and students from 43 countries and regions working or studying here.

Corlett attributed this success to China's opening-up and reform, growing global influence, and its unremitting efforts in strengthening international cooperation in biodiversity conservation.

Such efforts have brought remarkable achievements. Since 2015, XTBG has joined hands with scientists in Myanmar and Laos to carry out several cross-border expedition trips, during which more than 700 new species of animals and plants were discovered.

British conservation biologist Richard Corlett (C) talks with Chinese scholars at CAS's XTBG in Southwest China's Yunnan Province. [IMAGE: XINHUA/SONG CHEN]



Under Corlett's leadership as the director of the center for integrated conservation of XTBG, his team has become a significant player in tropical biodiversity conservation research in the Greater Mekong Subregion.

In 2016, Corlett received the Friendship Award from the Chinese government for his outstanding contributions to biodiversity conservation in China.

The 15th meeting of the Conference of the Parties to the Convention on Biological Diversity (COP15) was held in Kunming, the provincial capital of Yunnan. Corlett believes that the meeting will enable countries around the world to further acknowledge the need for ecological protection and sustainable development and promote the establishment of a practical post-2020 global biodiversity framework based on broad consensus.

He said that Yunnan's achievements in protecting its rich biodiversity resources make it a perfect place to host the meeting, which also reflects China's progress in this area as a whole.

Corlett said he was impressed by the concrete conservation action that was taken by the Chinese government, such as setting up ecological red-line zones and establishing national parks, which set examples for countries globally in reversing the common crisis of rapid biodiversity loss.

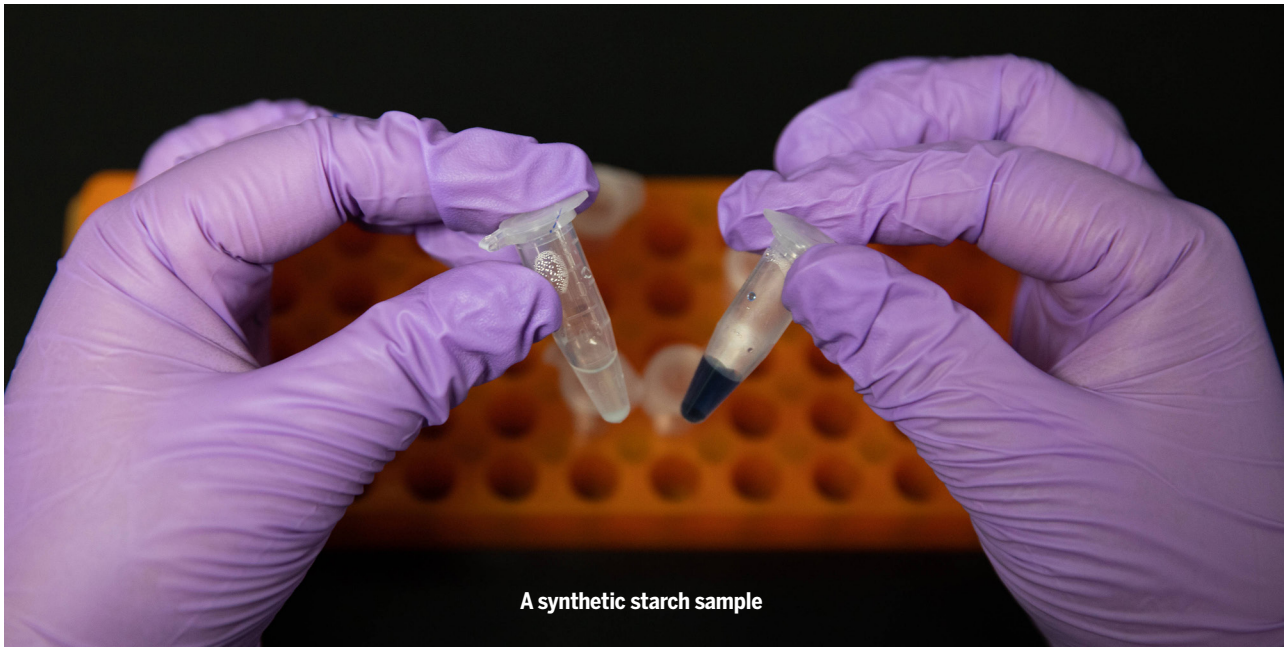
Corlett particularly hailed the China-proposed ecological civilization philosophy, which is also highlighted in the theme of COP15. "It's not simply a scientific idea. It's a policy push."

Source: Xinhua

Highlights of scientific and technological innovation achievements of the Chinese Academy of Sciences in third quarter of 2021

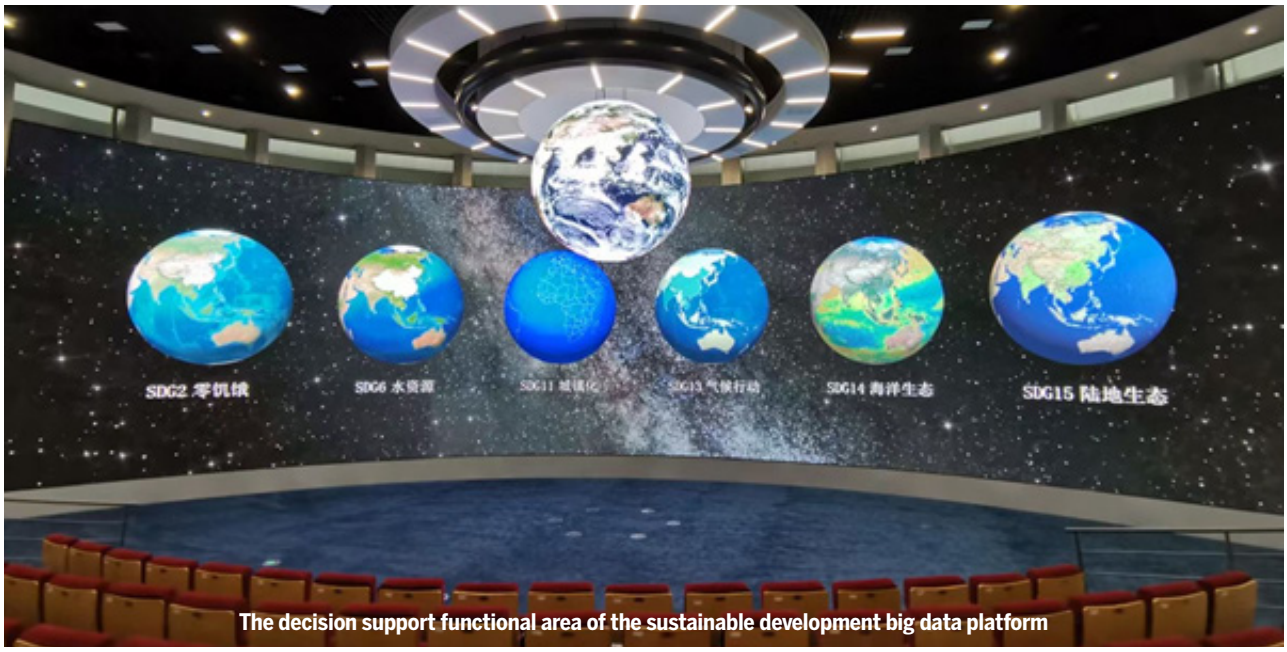
Following the recommendations of its departments and experts, and taking online voting results into consideration, the Chinese Academy of Sciences (CAS) has selected its scientific and technological innovation highlights for the third quarter of 2021.

The six scientific and technological innovation achievements are as follows:



A synthetic starch sample

1. Original breakthrough: a *de nove* route for artificial starch synthesis from carbon dioxide (CO_2)



The decision support functional area of the sustainable development big data platform

2. CAS builds and releases a sustainable development big data platform system

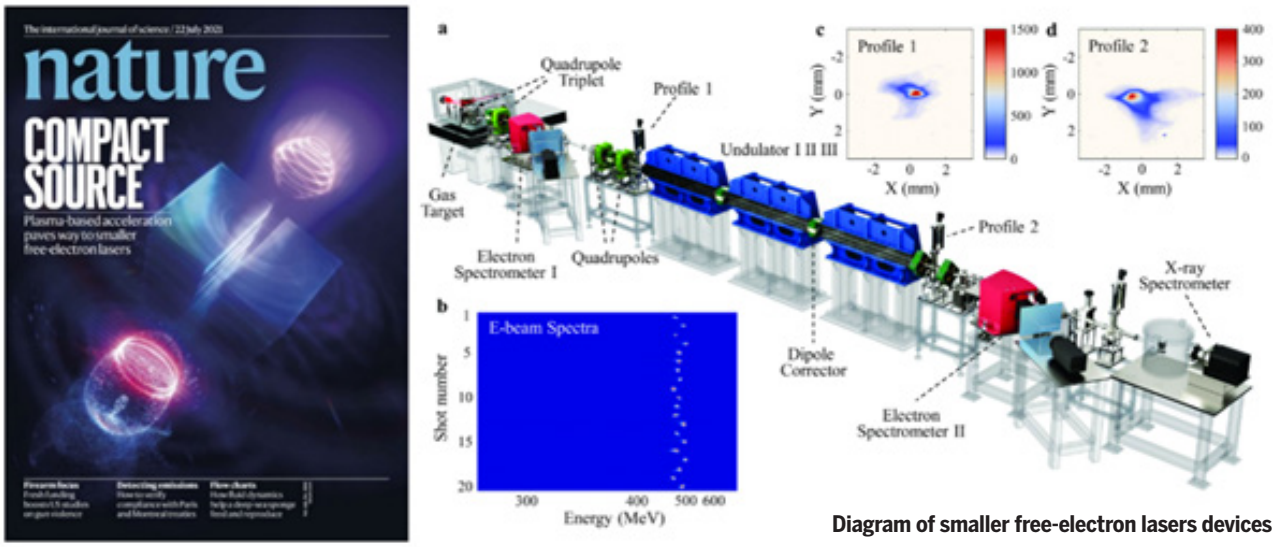
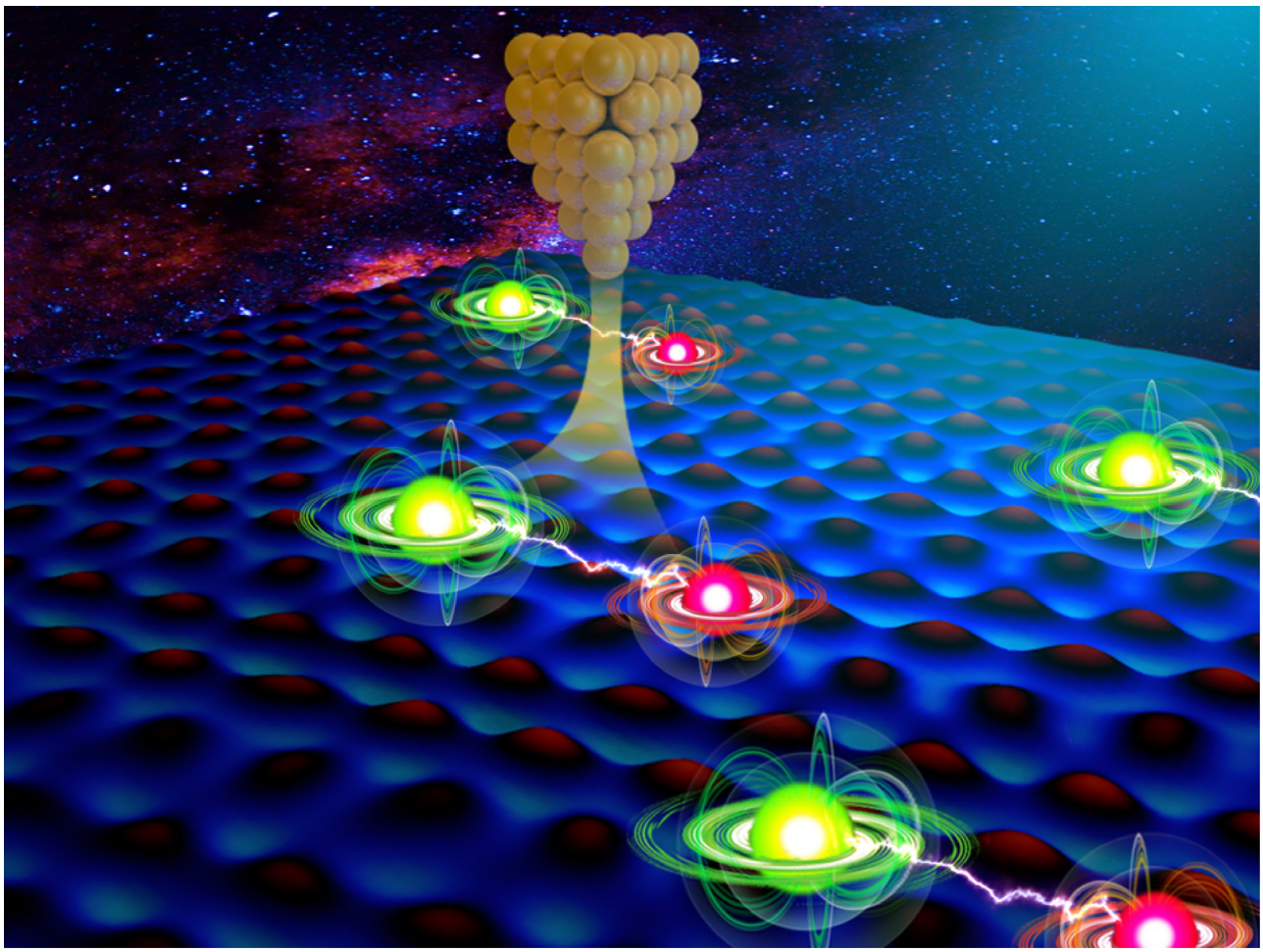


Diagram of smaller free-electron lasers devices

3. CAS scientists obtain free-electron lasing based on a laser Wakefield accelerator for the first time

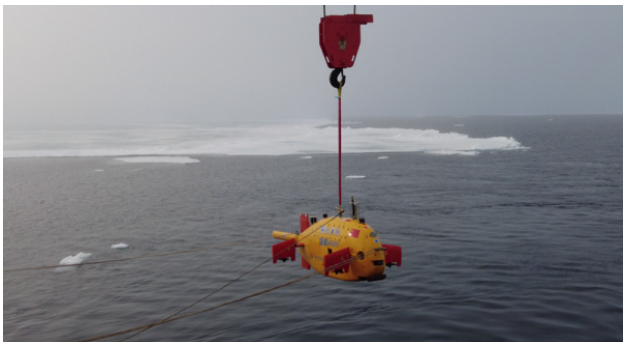


4. CAS scientists discover a roton pair density wave in a strong-coupling kagome superconductor

Aerial photograph of LHAASO

5. The Large High Altitude Air Shower Observatory (LHAASO) discovers ultra-high-energy cosmic accelerators with energy approaching the theoretical upper limit

China's unmanned submersible Haidou-1 ready for a 10,000-meter dive



China's 4,500-meter-level autonomous underwater vehicle ready for scientific research in the Arctic

6. Self-developed unmanned submersibles explore ocean's abysses and conduct polar scientific research

Source: Chinese Academy of Sciences