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CASNewsletter

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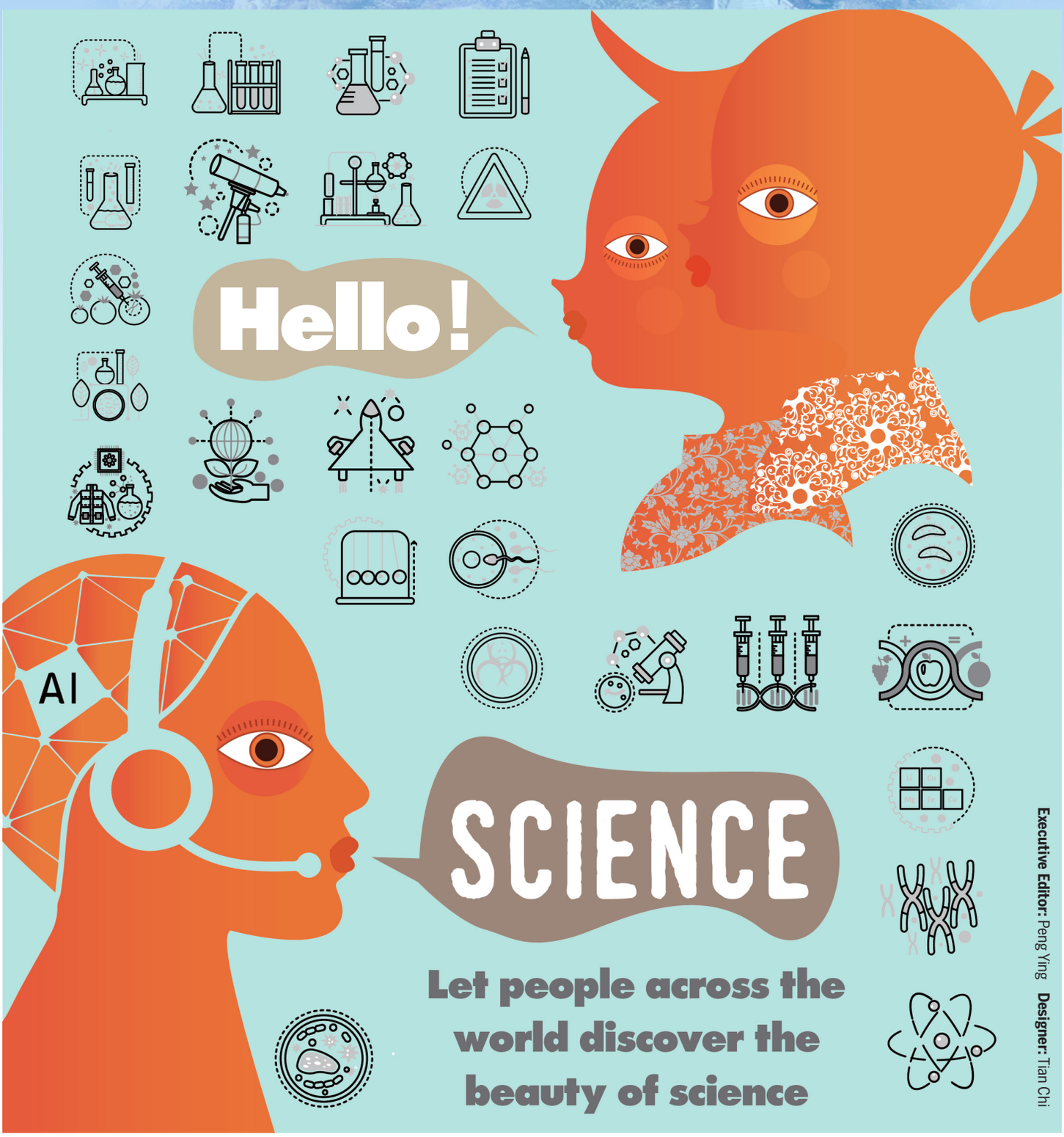
NO. 169 • November 2020



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Edited by Bureau of International Co-operation, Chinese Academy of Sciences
CAS Newsletter – Monthly – Editorial Board: 52, Sanlihe Road, Beijing, 100864, China

An outdoor activity is held during this year's CAS Science Festival.

CAS Science Festival returns

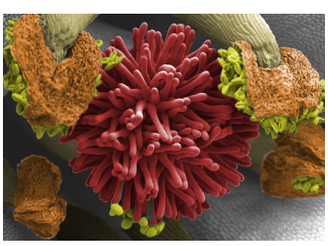
The Chinese Academy of Sciences held its third Science Festival from October 31 to November 6. Featuring more than 400 events nationwide, the two-day festival attracted more than 8,000 visitors plus over 10 million online viewers.

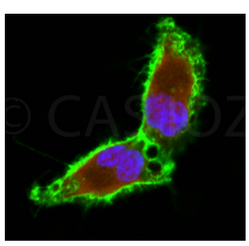
Source: Bureau of International Cooperation, Chinese Academy of Sciences

Curiosity will motivate people to explore new areas of knowledge, and science will lead us to a better life.

People attend an outdoor activity at CAS's third Science Festival.

THE CHARM OF SCIENCE





From left: A microphotograph of snowflakes taken by Jiang Chunyan, displayed during one of the science festival's exhibitions; The withered pollen on the anther of Arabidopsis thaliana is hydrated after falling to the stigma, showing its great vitality. This image, created by Tian Yanbao, shows the sprouting pollen tubes; A butterfly-like image by Cheng Chenxi shows the expression constructed by an A549 cell line.

Exchanges between Chinese and foreign scientific communities

Children explore secrets of 'artificial sun' with scientists

Scientists from China and Russia delivered an online lecture on the China designed-and-developed Experimental Advanced Superconducting Tokamak (EAST), the "Chinese artificial sun," on November 20, which also marked World Children's Day.

Qian Jinping and Wu Weiyue, researchers at the Institute of Plasma Physics, the Chinese Academy of Sciences (ASIPP) alongside a Russian scientist, focused on topics such as "whether the artificial sun will explode", "how to store its energy", and "whether the artificial sun will heat up the earth" in the lecture.

It provided children with an opportunity to interact with top scientists and explore the secrets of their work, as well as helping to nurture children's interest in science and technology.

Source: Bureau of International Cooperation, Chinese Academy of Sciences

CAS hosts webinar with Durham University

The Chinese Academy of Sciences and Durham University in the UK launched a series of webinars titled "Knowledge Across Borders" on October 29, both to promote bilateral cooperation and to explore new models for international scientific and technological exchanges against the backdrop of the COVID-19 pandemic.

Zhang Yaping, Vice-President of CAS and Stuart Corbridge, Durham University Principal, made speeches at the opening ceremony.

Zhan Renbin, head of the Nanjing Institute of Geology and Palaeontology, CAS and David Harper, a professor with Durham University, focused their lectures on the theme of "The First Carnival of the Animals: Causes and Consequences of the Diversification of Early Palaeozoic Marine Life".

The two lecturers introduced the impact of major biological events on the evolution of life on Earth since the Phanerozoic — the key driving factors of biological evolution. Important fossil evidence found in China and other regions was also presented during the online event.

The pair answered questions raised by online viewers and had further discussions with some of 350-plus attendees from China and the UK after the lecture.

Wang Zhenyu, deputy head of the Bureau of International Cooperation, CAS and Claire O'Malley, Vice-President in charge of Durham University's international cooperation affairs, made concluding remarks.

The two institutions have maintained close cooperation and developed flexible and innovative cooperation models in the context of the normalization of the global epidemic. The webinar was a product of this cooperation. It helped strengthen exchanges between the scientific and technological communities in China and the UK and advance their bilateral ties to a higher level.

Source: Chinese Academy of Sciences

International collaboration reveals China's carbon balance

An international team of researchers has compiled and verified newly-available data on the country's CO_2 sink and, for the first time, they have quantitatively estimated the effect of China's carbon mitigation efforts.

The researchers published their results on October 29 in *Nature*.

"China is currently one of the world's major emitters of CO_2, but China's forest resources have been growing continuously for the past 30 years," said paper author Liu Yi, professor at the Institute of Atmospheric Physics of the Chinese Academy of Sciences. "In this study, we achieve a better understanding of CO_2 fluxes across China", he said.

Previously, the CO_2 monitoring stations on the ground in China were few and far between, resulting in CO_2 flux estimates with large uncertainties. One monitoring station could represent a significant area that included distinctly different land use types. In addition, the lack of data resulted in fewer studies on CO_2 in China.

"Therein lies the crux of the challenge faced by science and policy communities: effective mitigation of fossil fuel CO_2 emissions within a large-scale dynamic natural carbon cycle that we do not quantitatively understand," Liu said.

"Without good data, it was nearly impossible to assess how China's forestry efforts to mitigate CO_2 emissions were actually faring," added Wang Jing, lead author of the study from the same institute.

That changed when the China Meteorological Administration started collecting weekly and hourly continuous atmospheric CO_2 measurements between 2009 and 2016, and made the figures available.

Liu and his team found that, between 2010 and 2016, China reabsorbed about 45 percent of the country's estimated annual human-made CO_2 emissions.

They corroborated that data with independent satellite remote-sensing measurements of vegetation greenness, soil water availability, satellite column observations of CO_2, and forest censuses.

"While our results still have large uncertainties, it's clear that China's forest ecosystem has a huge carbon sequestration effect," said paper author Paul I. Palmer from the School of GeoSciences at the University of Edinburgh in the UK.

The researchers plan to fine tune their results with more ground and satellite data, with the ultimate goal of improving their calculation methods to be able to determine the carbon budget of smaller areas, such as cities.

This work was supported in part by the Chinese Academy of Sciences, the UK Natural Environmental Research Council National Centre for Earth Observation, the European Space Agency, the Royal Society of London, the National Key Research and Development Program of China and the NASA Jet Propulsion Laboratory.

Other contributors include Yang Dongxu at the Institute of Atmospheric Physics, Chinese Academy of Sciences; Feng Liang with the National Centre for Earth Observation and the School of GeoSciences at the University of Edinburgh; Fang Shuangxi and Liu Lixin, both with the Meteorological Observation Centre of the China Meteorological Administration; Hartmut Bosch of the National Centre for Earth Observation at

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Southwest China is populated by fast-growing and high-yielding tree species with high potential biomass carbon sequestration. [IMAGE: HUANG YAOGAO AT THE DEPARTMENT OF FORESTRY OF GUANGXI ZHUANG AUTONOMOUS REGION]

Chinese researchers uncover link between phase separation and human developmental disorders

Noonan syndrome (NS) and Noonan syndrome with multiple lentigines (NS-ML) are rare human developmental disorders caused by mutations of the protein SHP2. Until recently, the mechanism of NS and NS-ML pathogenesis had been unclear, and nor was there any effective treatment for the disorders.

Now, however, researchers from the Shanghai Institute of Organic Chemistry (SIOC) of the Chinese Academy of Sciences have uncovered the mechanism that underlies the pathogenesis of NS and NS-ML.

They found that disease-associated SHP2 mutants acquire the capacity for liquid-liquid phase separation (LLPS) to boost enzymatic activity, leading to hyperactivation of the downstream cellular signaling pathway.

Phase separation has emerged as a fundamental mechanism that regulates various biological processes. However, very little is known about whether dysregulation of phase separation plays a role in human developmental disorders.

The team found that both NS and NS-ML mutations lead to gain-of-function LLPS of SHP2, explaining a long-standing puzzle as to why NS and NS-ML have similar clinical manifestations, although they have different SHP2 mutations.

According to the researchers, LLPS of SHP2 mutants is regulated by conformational changes in the SHP2 protein, and is potently inhibited by the SHP2 allosteric inhibitor ET070, which provides a therapeutic strategy of targeting SHP2 LLPS as a way of treating SHP2-associated developmental disorders.

This work also suggests the exciting possibility of using LLPS as a pharmaceutical target for developing new drugs.

The team believes that this study will offer new insights for understanding the link between LLPS and human disease, which will greatly help in the development of therapeutic approaches for treating disease. Their achievement in this regard was published entitled "Phase separation of disease-associated SHP2 mutants underlies MAPK hyperactivation" by *Cell* in its September issue of 2020.

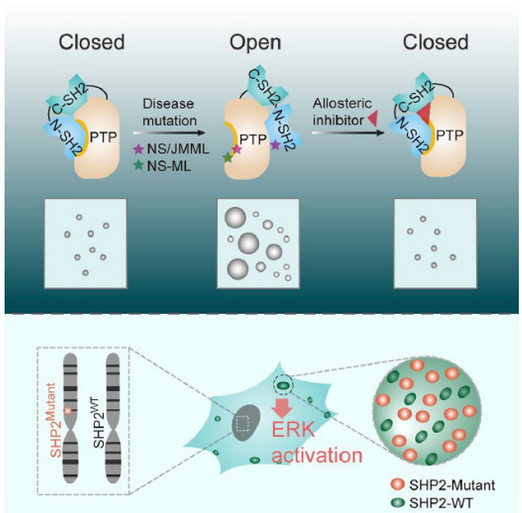

Figure: Disease-associated SHP2 mutants acquire the capacity for liquid-liquid phase separation (LLPS) to boost enzymatic activity, thus leading to MAPK signaling pathway. [IMAGE: INTERDISCIPLINARY RESEARCH CENTER ON BIOLOGY AND CHEMISTRY SHANGHAI INSTITUTE OF ORGANIC CHEMISTRY]

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Chinese Academy of Sciences

Source: Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences

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the University of Leicester; Christopher W. O'Dell of Colorado State University; and Tang Xiaoping and Xia Chaozong, both with the Academy of Forest Inventory and Planning in the State Forestry Administration. Wang is also affiliated with the University of Edinburgh, and Fang is also affiliated with the College of Environment at the Zhejiang University of Technology.

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Source: Institute of Atmospheric Physics, Chinese Academy of Sciences

Progress report of advisory trip to China Spallation Neutron Source in Dongguan, China

To the PIFI program committee,

It is my pleasure to receive the visiting scientist award of the Chinese Academy of Sciences PIFI program. I was invited to China by my former colleague who is now working at the China Spallation Neutron Source (CSNS), and wanted to hear my advice on their current development. As a neutron scientist who is always excited about new neutron facilities, I couldn't be happier about this opportunity to see China's efforts towards joining the neutron science society. With that in mind, I visited China in July 2019 to initiate the collaboration, and in November 2019 to participate in the CSNS polarized neutron workshop. Unfortunately, my next trip was throttled due to the pandemic and travel restrictions. Still, I continue to contribute to the research at the CSNS remotely and have discussions with the local development team.

During my first trip to China, I took a tour (Figure 1) through the CSNS facility and saw its ongoing development plan. My colleague and I recognized that there is much I can contribute from my several decades of neutron beamline development experience. Several key projects were identified after the tour, specifically in the area of polarized neutron development as per the local researcher's request. First, the development of polarized neutrons at the CSNS needs the establishment of infrastructure, including the neutron spin filter and neutron spin flipper. Second, it is equally important for the CSNS development team to also configure a proper control communication, so that each new piece of development hardware can be integrated into the existing data acquisition system.

Figure 1. Photo taken during a tour at the CSNS sand map in the office building

For the first project, it is crucial to develop a necessary platform for polarized neutron capability testing, which has been a key factor in other neutron sources that I have worked on. To support the local researchers working on such a development, I gave a few lectures

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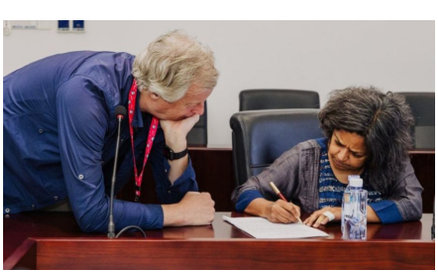

Figure 2. Photo of me (left) and my wife (right) writing suggestions and advisory notes during discussion with the researchers at the CSNS

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in terms of general beamline development and neutron scattering concepts. A few of the slides are demonstrated in Figure 3. Beyond the slide, a few hardware developments were also initiated with my recommendation, which include a Mezei flipper and a concept design of the polarized neutron testing beamline. Both developments have been constructed and are under development, as shown in Figure 4.

Figure 3. Photo of the presentation given at the CSNS (a) Neutron Optics and Instrumentation (b) Demonstration of beamline at spallation neutron source

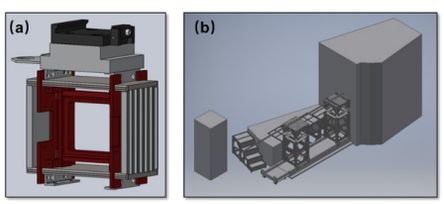


Figure 4. Schematics of developed instruments based on advisory (a) Mezei flipper for multiple wavelength neutron (b) Polarized neutron testing station

During my second trip in November, I attended the CSNS polarized neutron workshop along with other neutron scientists from around the world. The workshop discussed the current development progress at the CSNS and its vision for the future.

From an advice committee point of view, the workshop is a huge success in terms of connecting the newly-developed China Spallation Neutron Source with the international neutron science community, as well as setting the correct path for the facility to move forward.

During the workshop, we continued working on the previously identified project and pushed forward onto data analysis and communication. Currently, these projects are still in progress and the local developers at the CSNS are planning to test the newly-constructed Mezei flipper and construct the polarized neutron testing station. These bits of progress were made at the beginning of 2020, when the pandemic started to impact in-person travel around the world. Ever since then, I remain in contact with the researchers at the CSNS, and continue working on the instrument development through advising and lecturing.

With the current progress, the researchers at the CSNS and I are confident to complete the project, initiated in 2019, by the end of this year. The developed polarized neutron instrument and experiment method shall provide a long term benefit to future research at the CSNS, and hopefully the lectures I presented can help the people at the CSNS to join forces with the international neutron community. I look forward to continue participating in and assisting with neutron science development in China in the future.

Figure 5. Photo of me (left) and my wife (right) during the workshop presentation

Figure 6. Photo of all attendees at the CSNS polarized neutron workshop

William Anthony Hamilton,
Institute of High Energy Physics,
Chinese Academy of Sciences

Chang'e-5 lunar probe blasts off from Wenchang

China's Chang'e-5 robotic lunar probe was launched at 4:30 am (Beijing Time) on November 24 from the Wenchang Spacecraft Launch Site on the island province of Hainan, South China.

The probe, carried by a Long March-5 Y5 rocket, will enter Earth-moon transfer trajectory and bring back lunar samples about 20 days later.

The launch marks the start of China's first unmanned mission to collect soil and rock samples from the moon. It is also the first moon-sample mission in 44 years; the last one being the Soviet Union's Luna-24 mission in 1976.

The Chinese Academy of Sciences was the initiator, participator and implementer of the country's lunar exploration program.

Source: Chinese Academy of Sciences

China launches the Chang'e-5 lunar probe from the Wenchang Spacecraft Launch Site in the southern province of Hainan on November 24. [IMAGE: WWW.CLEP.ORG.CN]

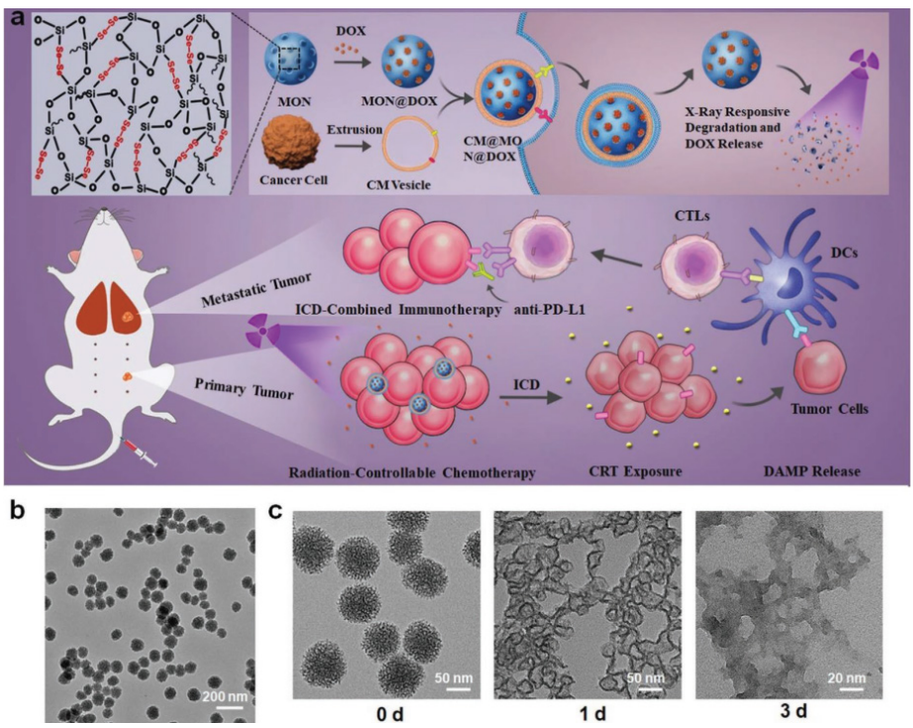
China's deep-sea manned submersible Fendouzhe returns

China's new deep-sea manned submersible Fendouzhe, or Striver, completed its ocean expedition and returned to a port in Sanya, South China's Hainan Province on November 28. It set a national record by diving to a depth of more than 10,000 meters during the expedition.

More than 10 institutes and organizations of the Chinese Academy of Sciences have been deeply involved in the facility's research and trials and offered great support to the country's scientific exploration and research in the deepest parts of the ocean.

Source: Chinese Academy of Sciences

China's deep-sea manned submersible *Fendouzhe* is lowered into the sea. [IMAGE: CHINESE ACADEMY OF SCIENCES]

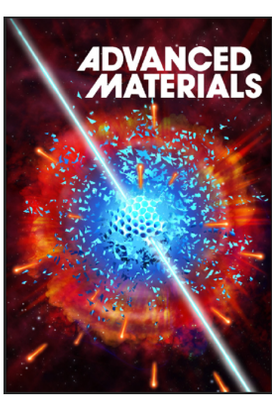


The synthesis and X-ray responsive manner of diselenide-bridged silica nanoparticles in chemo-immunotherapy [IMAGE: SIBET]

Scientists develop new X-ray responsive degrading nano-drug-carrying systems

Despite recent advances in chemotherapeutics, cancer remains a leading cause of disease-related death worldwide. While the clinical outcomes of conventional mono-chemotherapy on cancers remain unsatisfactory, the development of nanomaterials-based drug delivery systems may prove efficient and safe for use in chemotherapy.

In recent years, researchers have been exploring various smart nanocarriers that respond to internal stimuli such as changes in pH, redox potential, and enzymatic activity of tumor microenvironments. Mesoporous organosilica nanoparticles (MONs) are an inorganic-organic hybrid material with large surface area, tunable structure, good biocompatibility and controllable degradation properties which exhibit promising clinical application prospects. To further enhance the control of drug release, there is a critical need to fabricate nanocarriers that can respond to exogenous stimuli such as light, sound, electricity, and magnetism.



Un-released Front Cover of *Advanced Materials* [IMAGE: *ADVANCED MATERIALS*]

Recently, Professor Dong Wenfei's group from the Suzhou Institute of Biomedical Engineering and Technology (SIBET) cooperated with Professor Shao Dan from South China University of Technology and Professor Kam W. Leong from Columbia University. Together they discovered a new feature of the diselenide-bridged mesoporous organosilica material (10.1002/adma. 201801198); namely that it is an X-ray irradiation degradable material.

In their work they optimized the preparation process to obtain diselenide-bridged MONs with moderate particle size, pore size, and selenium content for loading the conventional chemotherapeutic doxorubicin. Such nanodrugs exhibit sensitive and controllable X-ray responsive degradation ability; the matrix can be rapidly disintegrated and the drug explosively released under low-dose X-ray (1 Gy) irradiation.

After cloaking tumor cell-derived cell membranes on the surface of the nanomedicine, the biomimetic nanomedicine achieved tumor-targeted and immune-evasive drug delivery by improving its stability and prolonging blood circulation. It effectively allowed for low-dose X-ray-mediated chemotherapy and significantly reduced the side effects of doxorubicin in vitro and in vivo.

This treatment strategy can also generate tumor-specific immune response by inducing immunogenic death of tumor cells. The combination of this treatment strategy with the use of immune checkpoint blockers can further promote the systemic anti-tumor immune response, which inhibits the growth of both primary and metastatic tumors.

Based on their excellent X-ray responsive degradation, diselenide-bridged MONs can be seen as a potential drug carrier for X-ray-mediated radio-chemotherapy.

As a result of this work, a paper entitled "Biomimetic Diselenide-Bridged Mesoporous Organosilica Nanoparticle as an X-Ray-Responsive Biodegradable Carrier for Chemo-Immunotherapy" was published in *Advanced Materials* and selected as the front cover image.

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