How Cool Are Chemists?

by He Yue, Lidong Han, Donna J. Minton, and Chunmei Deng

The United Nations declared 2022 as the International Year of Basic Sciences for Sustainable Development (IYBSSD 2022) [1]. Since 2022 was also the 90th Anniversary of the founding of the Chinese Chemical Society (CCS), CSS celebrated these two important events with a special outreach project aimed at bringing attention to chemists and the important work they do while also highlighting the creative and humanistic aspects of scientific research [2]. The "Chemist is Cool" (sic) Research Group Style and Creativity Competition was a great success, and CCS was honored to have it be selected as one of the featured activities of the IYBSSD 2022.

The Chinese Chemical Society is a scientific society focused on promoting and advancing the field of chemistry through public outreach and supporting chemists in China and around the world. Founded in 1932, CCS has become one of the largest international chemistry societies with more than 100,000 individual members and 175 organizational members. The society holds ~50 individual academic conferences every year, with the largest being the CCS Congress which had over 20,000 attendees this year [3]. CCS joined IUPAC as a National Adhering Organization (NAO) in 1979 and has been an active participant ever since.

Chemistry is often referred to as the "central science" and has made innumerable contributions to the progress and development of society in the past 200+ years. However, due to the field's vastness and complexity, difficulty to learn and communicate, and the harm caused through accidental or intentional misapplication, the public can at times view chemistry and its practitioners with suspicion. Inadequate communication and misunderstanding can result in resistance to and mistrust of the rapidly advancing field of chemistry, as well as of the researchers themselves.

The hope of CCS was that the "Chemist is Cool" competition, instead of focusing on academic prowess, would introduce a fun and creative way for the public to see that chemistry researchers are not so different from them. The competition was meant to encourage members of research groups to leave behind the countless hours in the laboratory or on computers, intense concentration, and rigorous research, for a fresher and more lively perspective of their research. As a result, this more relaxed view of researchers would provide the public with a new image of chemists and of the chemistry community that they don't often see, helping them to understand what chemists do and showing how basic science can contribute to the sustainable development of our society.

Qing He's research group from Hunan University.

The competition was open to chemistry research groups at colleges, universities, and research institutes in China, with each research group allowed to submit one entry. The event did not limit the number of group members participating or their region, gender, nationality, ethnicity, or research field. The submission requirements were a group photo and introduction to the research group. The photos were the key component of the submission and were based on the theme of daily teaching or scientific research of professors, students, and laboratories, with the members of the research group being at the core. The photos were to be original with no software modifications or additions, and the introduction was to include, but was not limited to, the research direction and interests of the research group, research progress, lab philosophy, motto, and stories of the research group and its members.

The competition lasted for six months, which included time for registration, collection of "sharing"

Yanping Huo's research group from Guangdong University of Technology.

and "likes" of all entries by the public, and an internal review. The competition received 108 entries from 78 universities and research institutes. Through the combination of public review, recorded number of "likes", and expert review, CCS selected 10 photos that were awarded the highest prize of the competition—the "Gold Medal of the Coolest Research Group." An additional 90 photos were awarded the "Silver Medal of the Coolest Research Group."

The 100 award-winning photos showed the unique and creative approaches taken by the groups, including intricate designs of group members' positions in the photos, dreamlike fluorescence experiments, challenges faced by scientific researchers, the spirit of having fun amidst hardships, young people's enthusiasm for their research, and reflections on scientific research and online communication during the pandemic. All of the award-winning photos are on display on the CCS website [4].

The photos show an encouraging trend in China's chemistry community. The number of women and young people devoting their lives to basic chemistry research is growing. In at least one of the entry photos, the majority of the group members were female researchers, showing the increasing presence of women in research. Another photo showed a row of young students with their backs to the camera while they gaze at their college's motto, which encourages young people to seek the truth from facts, be down-to-Earth in their studying and scientific research process, become pillars of talent that benefit society, and at the same time become virtuous people who contribute to society.

The "Chemist is Cool" competition was a huge success. Through it, the walls of academia were lowered giving the public a glimpse into the lives of chemistry researchers to see that they aren't all simply boring and serious people in white lab coats. They are fun, creative, exciting, and enthusiastic people who just happen to love scientific learning and discovery. It is through the dedicated efforts of scientists—like those who participated in the "Chemist is Cool" competition—and their willingness to stay in touch with their humanity and society that chemistry will continue to make further advancements towards the sustainable development of society and a better life for all mankind.

References

1. General Assembly Adopts Consensus Resolution Spotlighting Unifying Power of Sport, as Delegates Note Complex Global Landscape Ahead of Beijing Winter Games. Delegates Also Adopt Resolution Proclaiming 2022 International Year of Basic Sciences for Sustainable Development, https://press.un.org/en/2021/ga12391.doc.htm
2. Chemist is Cool, https://www.chemsoc.org.cn/90year/group/
3. Introduction to the Chinese Chemical Society, https://www.chinesechemsoc.org/about
4. Chinese Chemical Society Cloud Library, https://www.chemsoc.org.cn/library/

Chunmei Deng, Ph.D. is the Deputy Office Director at CCS. She may be contacted at: cmdeng@iccas.ac.cn. He Yue, M.S. is the Director of Academic Awards at CCS. Lidong Han, M.S. is the Director of International Affairs at CCS. Donna J. Minton, Ph.D. is the Director of Publications at CCS.

"Chemistry is Cool": The Interviews

We asked each group leader of the ten Gold Medal winners some questions about their inspirations, experiences, and advice. Below is a selection of responses we received.

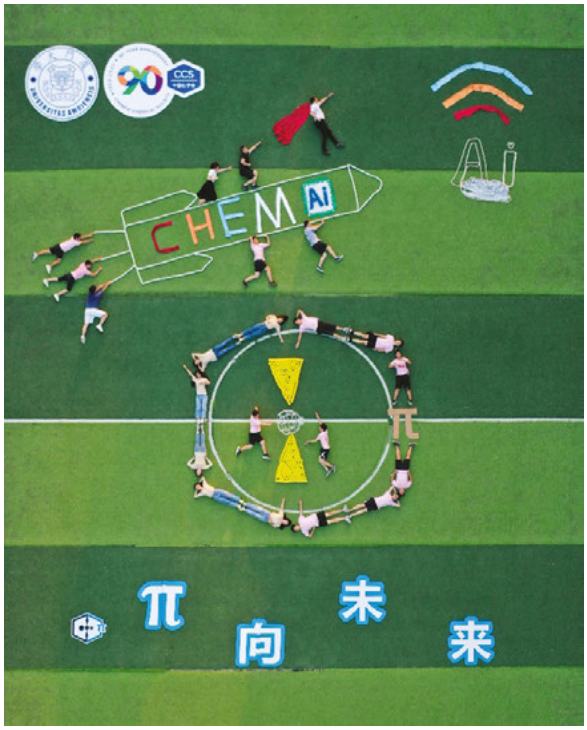
Q1. Could you tell us a little about your chemistry background? What kind of chemistry do you find exciting? What attracted you to the study of chemistry and becoming a professor?

Wenjing Hong: Actually, my first degree wasn't in chemistry, and I got a bachelor's degree in chemical engineering, more specifically, artificial intelligence (AI) driven process control. Then I turned to electrochemistry under the supervision of Gaoquan Shi at Tsinghua University during my master's study. After that, Prof. Wandlowski at the University of Bern, Switzerland, provided me with a Ph.D. position in molecular electronics. The idea is to create electronic devices and even integrated circuits using the knowledge of chemistry.

I enjoy the interdisciplinary study of chemistry. Actually, my research projects cover a wide range of chemistry, including synthetic chemistry, analytical chemistry, physical chemistry, and even theoretical chemistry. I am now serving as the senior editor of *Langmuir*, which is also a highly interdisciplinary journal.

I really get excited by the idea of using intelligent instruments and data analysis code to investigate the world of physical chemistry at the single-molecule level. And I have a dream of creating intelligence from molecules, which is the major driving force for me to become a professor.

Xu Wang: I am engaged in the research on the synthesis and processing of new green functional polymer materials, which is fascinating by the design of different monomers to form linear, star-shaped or dendritic polymers, and then to form products suitable for different occasions. This is what attracts me to research. Different monomers, initiators, chain extenders, and even small group changes will make the performance of the final product completely different. The wonderful and endless change brought about by this combination is the true meaning of chemistry that I am looking for.



Wenjing Hong's research group from Xiamen University.

Li Li: The love for chemistry began to germinate in my mind since high school. My headteacher was a respected and patient chemistry teacher, and I became greatly interested in chemistry under her influence. An important moment was when I got a high score in chemistry during College Entrance Examination and thus admitted to the Chemistry Department of Northeast Normal University. From then on, I felt chemistry had a magic charm for me. Therefore, I devoted myself to teaching and scientific research in basic chemistry at Qiqihar University for over 30 years, and at the same time continued to study and obtained master's and doctoral degrees in Northeast Normal University. After being promoted as a professor in 2008, I gradually established my own group to engage in research on photocatalytic properties of composite materials.

Q2. How did you choose your photo style? What do you think the style says about your research group?

Qing He: The idea of our group photo originated from Avalokiteshvara, Thousand-hand Kuan-Yin, in Buddhism. We intended to use this photo to show a young, energetic, optimistic, enthusiastic and hard-working research group to the public. The He Research Group at Hunan University was established

Weihong Tan's research group from Hunan University and Institute of Basic Medicine and Cancer (IBMC), Chinese Academy of Sciences.

in March 2019. I, as the group leader, am at the front of the line, leading the entire group to develop new functional macrocycles and cages, *e.g.* superphanes. All group members stand behind me, holding their own tools. Some students hold experimental tools while others show sports equipment, indicating that we work hard and stay healthy. We are working together, happily and freely explore our interests within the supramolecular world.

Wenjing Hong: Our group nickname is "π-lab" instead of Prof. Hong's group. The symbol π means infinite possibilities, just like our scientific research. The lab always has a relaxed, energetic, and diversified style, and most group members join us to explore interesting ideas in science. Therefore, we want to take "Power of Youth and Diversity of Thinking" as the theme of the photo. Hence we chose a vast football field to be our shooting spot, and the drone captured the scene, representing the multiple elements we wanted to convey perfectly.

There are four main symbolic elements in this picture which include the hexagonal benzene ring, the gold electrodes, the fullerene, and the rocket. The hexagonal benzene ring is posed by our group members, symbolizing the cohesive cooperation among everyone in the group. Meanwhile, the gold electrodes and fullerene between them represent our team's research at the single-molecule scale. Finally, the rocket represents our ultimate goal which is the collaboration of chemistry and artificial intelligence. And the people on this rocket mean we all did our best to build this special "lab rocket" together.

Liangliang Zhu: Our photo is to show a pattern of light-emitting three primary colors (RGB) formed by the group members. This photo style is quite related to our research regarding organic/polymeric luminescent materials. In this photo, the outermost students are dressed in red, green, and blue, featuring the three RGB primary colors. The students standing in the intersection region are in purple, cyan, and yellow, reflecting the generated luminescent colors through each corresponding primary colors. The group leader and three postdocs standing in the middle wear white lab coats, corresponding to the meaning of white light generated by the three primary colors RGB together. This photo not only features our warm group family, but also represents the luminescent color combination and transformation ability of the materials we study.

Liangliang Zhu's research group from Fudan University.

Q3. What do you think is the most important thing the general public should know about your research and research group?

Weihong Tan: I think it should be aptamers. Aptamers, known as chemical antibodies, are single-stranded nucleic acid oligonucleotides that can selectively bind to a specific type of target. Aptamers show great potential owing to their excellent properties compared to antibodies, such as feasible modification, high specificity, smaller physical size, and lower immunogenicity and toxicity. As we all know, antibodies have made great contributions to the development of life sciences and medicine. Therefore, I have a strong faith in aptamers. In 2006, my group developed a new aptamer selection technique which is called "cell-SELEX," and we successfully obtained the first aptamer targeting leukemia cells. Instead of using a purified molecule as a target for the selection, we were using the complex living system as the target. Aptamers selected in this way will be directly used for the cancer cells. We have selected over 300 aptamers for more than 10 cancers including leukemia, lung cancer, pancreatic cancer, and so on. Using these aptamers, we identified cancer biomarkers for leukemia, esophageal cancer, lung cancer, breast cancer, pancreatic cancer and liver cancer, which provide molecular fundamentals for cancer precise diagnosis and targeted therapy.

Xinhua Gao: Our group is interested in the utilization of carbon dioxide, but I want the public to know not only about our work, but also about the significance of our work. As we know, China has promised the world that its carbon dioxide emissions will peak in 2030 to prevent global warming and will strive to achieve carbon neutrality by 2060. The protection of the environment requires everyone efforts. The capture, utilization and storage of carbon dioxide has great potential for emission reduction and is an important means to achieve energy and environmental protection. Our job is to convert CO_2 into high-value chemicals and fuels, which has a clear and direct CO_2 reduction effect.

Q4. Since 2022 was the International Year of Basic Sciences for Sustainable Development, what do you think is the most important role chemists have in creating a sustainable future?

Liangliang Zhu: I think chemists can make a great contribution to a sustainable future. Any atom economic synthetic methods, any rapid and high-efficient catalysts, and any high-efficient emissive, energy, or

energy conversion materials, are making contributions to the sustainable future from the perspective of saving manpower and material costs. In addition, there are more and more chemical research topics involving interdisciplinary characteristics of environmental protection, which also indicates a good result.

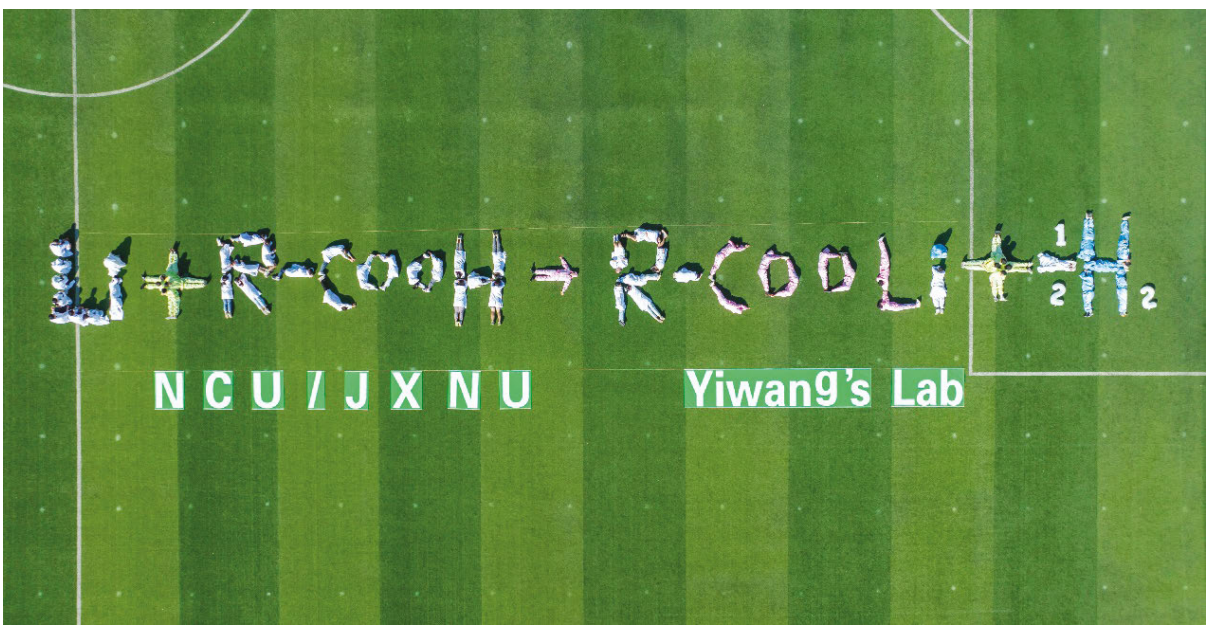
Xinhua Gao: I believe that the role of chemists is not only to innovate and develop energy-saving and efficient green chemistry, but also to educate the public about environmental protection concepts. Sustainability and the protection of the environment are everyone's responsibility, and chemists need to make their work known and supported by the public while doing their job. We hope that through the unremitting efforts of each and every one of us, we can truly achieve sustainable development in the future.

Li Li: Energy shortage has become one of the major issues affecting the sustainable development of human society. Chemists and chemical engineers should play a role in the following areas: efficiently utilizing solar energy, efficiently storing electricity, developing advanced nuclear energy systems, mastering the preparation and storage methods of hydrogen energy, and developing catalysts for energy applications.

Hydrogen, as a clean energy, is an ideal energy source for the future. In recent years, our research team has been devoting to carry out research on highly efficient photolysis of water to produce hydrogen composite materials, hoping that we can contribute a little to the "sustainable development of human society".

Q5. Can you briefly describe one fun or rewarding event that happened recently in your research group?

Weihong Tan: I think the event that makes me most proud is that I won the Shulan Medical Award in 2022. This award was set by the Academician Shusen Lanjuan Talent Foundation and received reputation of "China's Nobel Prize in Medicine." It has great influence in the fields of medicine and public health in China. The Shulan Medical Award is dedicated to rewarding the talents and developing education. Since I returned to China as a full-time professor in 2009, I have always been committed to finding new methods for disease early diagnosis and cancer therapy with my arsenal in molecular science, and to realize my dream of "molecular medicine to defeat cancer." Over these years, my group has focused on the application of aptamers as the molecular probes. Combined with various technologies including bio-nanotechnology and molecular engineering technology, we have developed a series of aptamer-based diagnosis and treatment platforms. I feel honored to receive this important award, and I cherish it very much because it is like the biggest milestone in my research career so far. I will treat this event as a new starting point and continue my adventure on the road of molecular medicine.



Yiwang Chen's research group from Jiangxi Normal University.

Left: Xu Wang's research group from Zhejiang University of Technology.

Left Bottom: Xinhua Gao's research group from Ningxia University.

Li Li: For a long time, I believe that creativity requires a relaxed environment and atmosphere. Communication should come into being normal and a team culture should be established. The casual communication within group is a very important process, and it should become an unconscious habit during cultivation process. Although serious and formal communications are essential, it is not easy to light up the flame of thinking in daily communication. Being too serious also hinders people's imagination and creativity to a certain extent. In my opinion, science requires rigorous logic, as well as an open mind to demonstrate a process with bold imagination and careful verification. Therefore, I have been trying my best to create such a team atmosphere, such as taking photos of members on campus, to make everyone share their thoughts. This competition organized by Chinese Chemical Society was very good and gave us an opportunity to cultivate a relaxed and lively atmosphere for our team. Thanks very much to the CCS.

Xinhua Gao: I think the most meaningful thing that happened to our research group was during the photo shoot, when the epidemic was raging, everyone voluntarily isolated in the laboratory in order not to delay the progress of their experiments. In nearly two months of laboratory life, everyone's daily life is experimentation. The inconvenience of accommodation and washing did not wear down the will of the students, everyone helped each other, gave encouragement to their peers, and strengthened their determination to do scientific research. Scientific research is hard, persistence is cool. This memorable time was truly meaningful and cool.

Q6. Do you have any advice for young students interested in a career in science?

Qing He: I always tell my students that "no matter where you want to go, you should begin from where you stand." As young students, they should try their best to learn theoretical knowledge and establish their own experimental skills and techniques, in order to lay a solid foundation for their long-term scientific career. Then learn how to generate and validate new ideas, which allows young students to think and act independently. Effective communication with their supervisors is somewhat critical to how far and how fast they can push their science forward. Learn to work together, from which young students are able to find some of their solutions relatively easily. Whereas, that is not enough: like a mountaineer to get to the top of a mountain, a scientist, sometimes, has to learn to "walk alone", especially when new and big science appears.

Liangliang Zhu: Do not try to set any specific goals about research achievements, because research is always slower than we expected. However, please believe in the brilliance that scientific research can finally bring to us.

Weihong Tan: The road of scientific research is bound to be an extraordinary journey. If you want to see different beautiful scenery during this journey, I hope you can insist on these following things: The first is improve efficiency in daily scientific research life, to establish your own scientific research system, and to make good use of scientific research tools, manage time carefully, think and learn more, and focus on research. The second is to have the will to stick to your scientific dream, to have the courage and tenacity to make self-breakthroughs, and to seek innovation from the interdisciplinary research. Failure experiences are often precious wealth. The third is to find the right direction and goals, to calmly examine the meaning of the work from time to time, and always ask yourself whether your research can solve major basic scientific problems and whether it can meet the major needs of the country. In the end, when you work together you are stronger.

Q7. What does it mean to you to be a "Cool" chemist?

Weihong Tan: Becoming a "cool" chemist means I must first insist on viewing the world, understanding biology, and doing medicine from a molecular perspective, and insist on not being bound by the invisible "boundary" of traditional disciplines. Make every choice and change closely related to the development of the era, and strive to make due contributions to the era. Secondly, arm yourself with "self-breakthrough" and fully explore your potential with the belief that "All things in their being are good for something". To write a new chapter worthy of the value of life, to serve for scientific innovation, and for the well-being of the people. Finally, I will fulfill my duty of "teaching and educating people", pass on knowledge to the next generation, and help more young scientists in chemistry to make breakthroughs and realize the value of life.

Xu Wang: I particularly like Mr. Jia Xi Lu's definition of a chemist: the element composition of a chemist should be C3H3, that is, Clear Head + Clever Hands + Clean Habit . This sentence is also engraved on the cover of everyone's data log book on our team.

Top: Zhouguang Lu's research group from Southern University of Science and Technology

Bottom: Li Li's research group from Qiqihar University.

Xinhua Gao: In my opinion, being a "cool" chemist means that the team is able to maintain unique creativity. Since you want to be cool, you have to be attractive enough. Cultivating talents can be tailored to their aptitude, and each member of the team has sufficient room for development, so as to attract talents. Getting along with students is also important, whether it is scientific research or life, it can help them. In the hands of "cool" chemists, scientific research that may be boring in the eyes of others can be made interesting and meaningful, and at the same time attract public attention, learn about their own research, and support it.