



report

# The Development of the Radiation Processing Industry in China

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中国同位素与辐射行业协会  
CHINA ISOTOPE & RADIATION ASSOCIATION

## About this document

This document provides an overview of the status of radiation processing and nuclear technology applications in China. It is a collaboration between the International Irradiation Association (iia) and the China Isotope & Radiation Association (CIRA). This report includes data collected during 2025.



## Foreword

The isotope and radiation industry, or nuclear technology application industry, encompasses applications in agriculture, medical and health care, environmental governance, resource exploration, public safety and other industries. It now serves society and the public, including reactors, radioactive isotope products, industrial accelerators, radiation chemical engineering of materials, food irradiation, agricultural breeding, medical device sterilisation, non-destructive testing equipment, environmental governance, and safety testing.

Radiation processing is one of the most important fields in the nuclear technology application industry. It uses ionizing radiation, such as gamma rays from radiation devices, electron beams or X-rays from accelerators, and other sources, to process products. This processing changes their physical, chemical, or biological characteristics, increasing their usefulness and value, or reducing their environmental impact.

After years of development, China has established a comprehensive R&D and production platform for radioactive isotopes, including reactors, accelerators, and research and production facilities for radioactive isotopes. It has mastered the preparation technologies for various radioactive isotopes, with production capacity for some isotopes. Significant progress has been made in the production and preparation technology of industrial radioactive sources, and industrialisation has been gradually achieved. The design and construction of radioactive source irradiation devices is moving towards the international market, and isotope tracer technology has been widely applied in agriculture, environmental protection, and other fields. The nuclear detection instrument industry has taken initial shape, with dozens of types of industrially produced nuclear detectors available.

Technologies for applied accelerators in China, such as industrial irradiation accelerators and non-destructive testing accelerators, are becoming increasingly mature, and the level of industrialisation is gradually improving. A large number of industrial irradiation electron accelerators have been widely used in various fields. The production capacity of industrial non-destructive testing electron linear accelerators can now meet the domestic demand. Cargo security inspection and industrial CT technologies are at the world's most advanced level. The application of radiation technology in environmental governance is remarkable, especially in recent years with encouraging achievements in the electron-beam treatment of industrial printing and dyeing wastewater, medical wastewater, and pharmaceutical wastewater.

### China's radiation processing technology mainly consists of the following four parts:

1. Radiation Chemical Engineering: radiation cross-linked cables, heat-shrinkable materials and products, foamed materials, tyre pre-vulcanisation, radiation grafted membrane materials, printing and dyeing coatings, surface treatment material curing, etc.
2. Radiation Processing Services: radiation processing of agricultural, food and associated products, sterilisation of medical and health care supplies, import and export quarantine, etc.
3. Environmental Governance and Public Security Assurance: focused on wastewater treatment, toxic and hazardous solid waste treatment, flue gas purification; safety testing and detection of specific substances, etc.
4. Radiation Technology Equipment Manufacturing: design and manufacturing of gamma devices and electron beam radiation equipment, ion implantation equipment, and various types of testing equipment.



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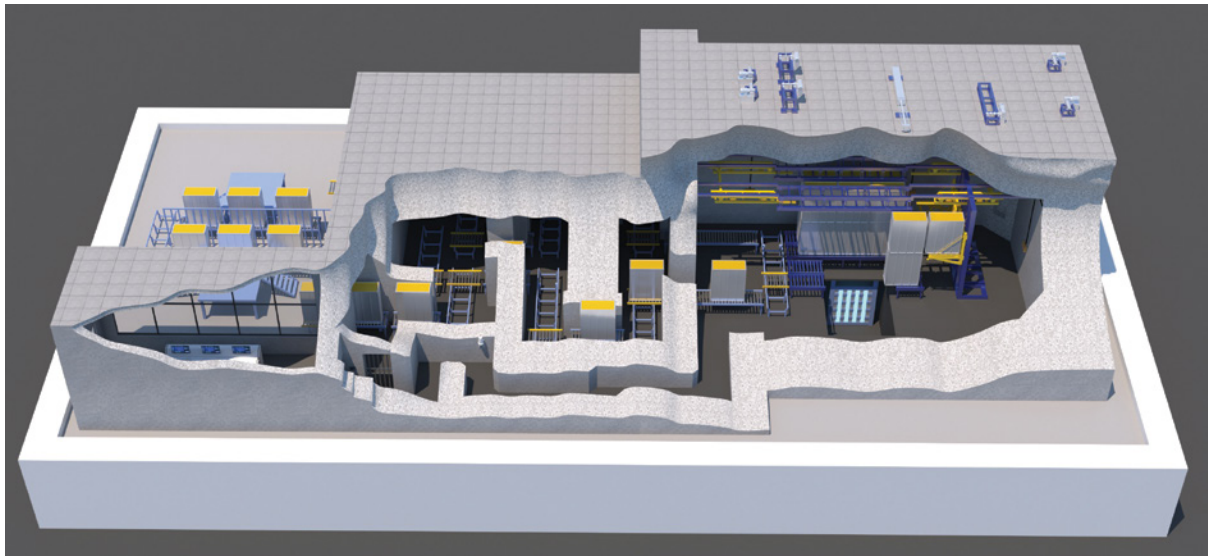


# 1. Current Status of Radiation Processing Equipment

## 1.1 Gamma Irradiation Facilities

As of the end of 2024, there were 105 gamma irradiation facilities nationwide, with a total designed source loading capacity of  $7.289\text{E}+18$  Bq (198 million Ci) and an actual source loading capacity of  $2.035\text{E}+18$  Bq (55 million Ci). Approximately 7 million Curies needs to be replenished each year.

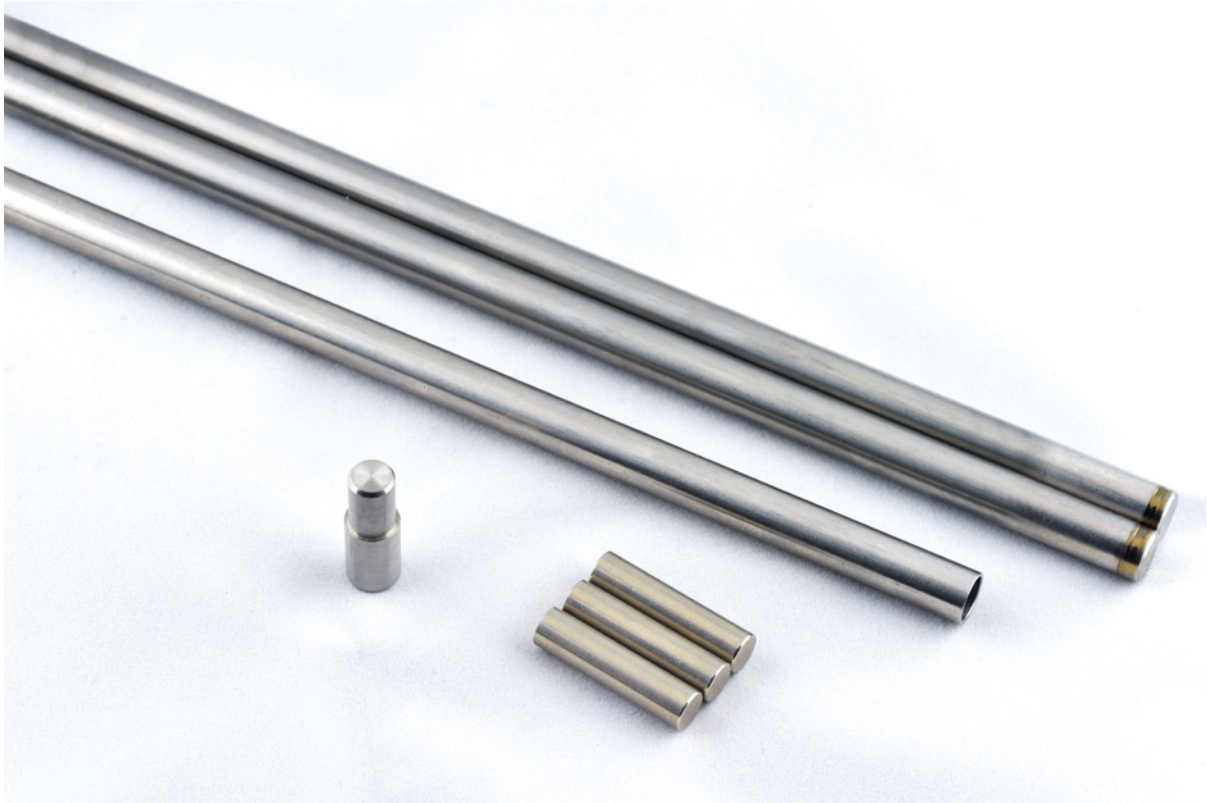
Figure 1: Gamma Irradiation Facility (Photo provided by BINE)



There are three qualified companies for the design and production of gamma irradiation facilities, with no changes in recent years. They are Bini Company of China Isotope & Radiation Co., Ltd., Beijing Sanqiang Nuclear Power Radiation Engineering Technology Co., Ltd., and Beijing Atom High-tech Jinhui Radiation Technology Co., Ltd. In addition to meeting domestic demand, they also provide services abroad. In recent years, they have successively exported to Thailand, Vietnam, Malaysia, and Bangladesh. Recently, service contracts have been signed with Brazil, Peru, and other countries to provide professional gamma irradiation facilities and supply a complete solution for supporting  $^{60}\text{Co}$  sources for irradiation. The continuous advancement of these collaborations will further enhance the export quality and market competitiveness of agricultural products in these countries, and play a positive role in promoting food security and sustainable agricultural development.

Cobalt-60 has been produced in China since 2010. CN -101 Cobalt-60 sources are distributed to users for radiation processing by Tongxing Company, a subsidiary of China Isotope & Radiation Corporation (CIRC).

**Figure 2:** Co-60 Industrial Source (Photo provided by Tongxing)



## 1.2 Electron Accelerator Equipment

As of the end of 2024, there were approximately 12 manufacturers of electron accelerator equipment for radiation processing nationwide. The equipment is mainly used for chemical product material modification, medical device sterilisation, and food processing. As of the end of 2024, there were approximately 1,313 electron accelerator devices actually installed and in operation for radiation processing nationwide, with a total power of approximately 94,009.7 kW.

China-manufactured electron accelerator machines have been exported to various Asian nations such as India, Thailand, Vietnam and Indonesia etc., with exports to European and American countries also being realized.

**Figure 3:** Linac EB Facility (Photo provided by CGN Dasheng)



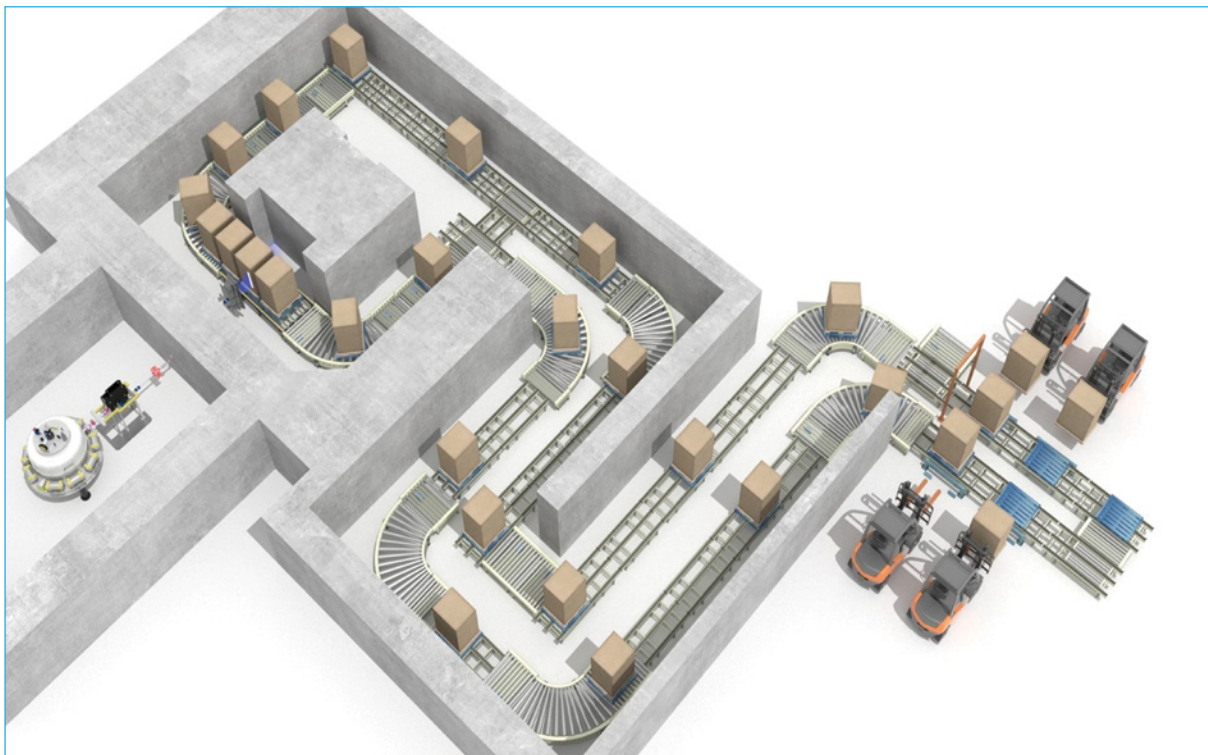
### 1.3 X-ray Equipment

X-ray radiation is a highly penetrating technology. In most cases, products with large surface density, such as food, require highly penetrating radiation. In addition, X-rays are an effective choice for processing goods in large packages or placed on pallets. An advantage of processing food on pallets is minimising damage caused by handling.

The use of X-ray technology has become an alternative to gamma rays and electron beams, leading to more disinfection and sterilisation application scenarios, and will play a role in the field of radiation curing.

In China, there are currently about 6 electron beam accelerator devices with EB-X-ray conversion functions, mainly used for the sterilisation of large-volume packaged medical device products.

**Figure 4:** X-ray Facility (Photo provided by ThreeRays)



## 2. Main Applications of Radiation Processing

### 2.1 Radiation Sterilisation of Medical and Sanitary Products

Radiation sterilisation of medical and sanitary products is one of the core application directions in the radiation processing field, currently accounting for about 12% of the entire industry. Boasting mature technology and broad development potential, it serves as an important technical means for achieving sterility assurance in the medical and health sector. This technology utilizes ionizing radiation such as Cobalt-60 gamma rays and electron beams generated by electron accelerators to achieve sterilisation by damaging the DNA structure of microorganisms. It features outstanding advantages including no chemical residues, thorough sterilisation, room-temperature processing, and direct sterilisation of sealed finished products, which perfectly aligns with the sterility requirements and production and circulation characteristics of medical and sanitary products. It is widely applied in the sterilisation of various medical consumables such as disposable medical masks, protective clothing, surgical instruments, syringes, infusion sets, medical dressings and sterile packaging materials, as well as high-end medical equipment accessories and biomedical materials.

At present, a mature industrial system for radiation sterilisation of medical and sanitary products has taken shape in China. Leading enterprises, relying on core equipment such as Cobalt-60 radioactive source devices and industrial electron accelerators, have realised large-scale and standardised sterilisation services. These services not only meet the demands of medical institutions at all levels and medical consumable manufacturers across the country, but also provide sterile certification support in line with international standards for the export of medical products, adapting to the sterility testing requirements for medical products in Europe, America, Southeast Asia and other regions. With the continuous improvement of China's medical and health system, the steady enhancement of public health systems and control, and the development of high-end medical consumables, the market demand for disposable medical products is growing steadily. Meanwhile, the increasing requirements for sterility assurance in fields such as biomedicine and minimally invasive medicine are bringing sustained market growth for radiation sterilisation of medical and sanitary products. In addition, due to its technical advantages in low-temperature processing and the sterilisation of products with complex structures, radiation sterilisation technology is gradually replacing some traditional sterilisation methods, continuously expanding the industry's development and its emergence as a highly promising sub-sector in the radiation processing field.

### 2.2 Food Irradiation

Relying on the technological accumulation and equipment iteration of the entire radiation processing industry, food irradiation in China has become a key technical means for fresh-keeping, sterilisation and quality improvement in the food industry, and an important application direction with both practicality and development potential in the domestic radiation processing field. At present, this technology has been applied on a large scale in food sterilisation, shelf-life extension and sprouting inhibition, covering various categories such as meat, aquatic products, fruits and vegetables, condiments and grain. It realises the harmless treatment of food through radiation processing devices such as electron accelerators and Cobalt-60, which not only meets the core demands of the food industry in terms of health and safety, storage and circulation, but also is highly in line with the development trend of green processing in the industry.

## 2.3 Radiation-induced Material Modification

Radiation-crosslinked wires and cables represent the largest sub-sector in the current radiation processing field, accounting for 63% of the total market share, and also the fastest-growing track, with dozens of relevant domestic manufacturers. Large-scale production of radiation-induced heat-shrinkable material products has been formed, and the market demand for power-related heat-shrinkable materials remains stable. Special functional films developed based on radiation grafting technology, such as diaphragms for new energy batteries, functional films for photovoltaic cells and reverse osmosis membranes for seawater desalination, have become core breakthroughs for the development of emerging manufacturing industries and the technological upgrading of traditional industries, and are widely used in various industrial fields.

## 2.4 Radiation Curing

The development of the curing field presents an unbalanced pattern: there is a significant gap between China's ink curing sector and the international advanced level, while electron beam curing for coatings of flexible sheets such as composite panels of white household appliances and for plate materials is just emerging, and the relevant application in high-end furniture decorative panels is in the initial stage. The market recognition of electron beam coating curing technology still needs to be improved. In the future, with the gradual reduction of costs, this technology will provide strong technical support for the industrial upgrading of the wood industry. At the same time, the application of electron curtain accelerators in surface curing and thin material processing is gradually forming a new growth point for the radiation processing industry. Independent innovation and industrial application of radiation vulcanization technology for rubber tyres have been achieved, yet its market share in the overall radiation processing market is still relatively small at present.

## 2.5 Radiation-based Wastewater Treatment

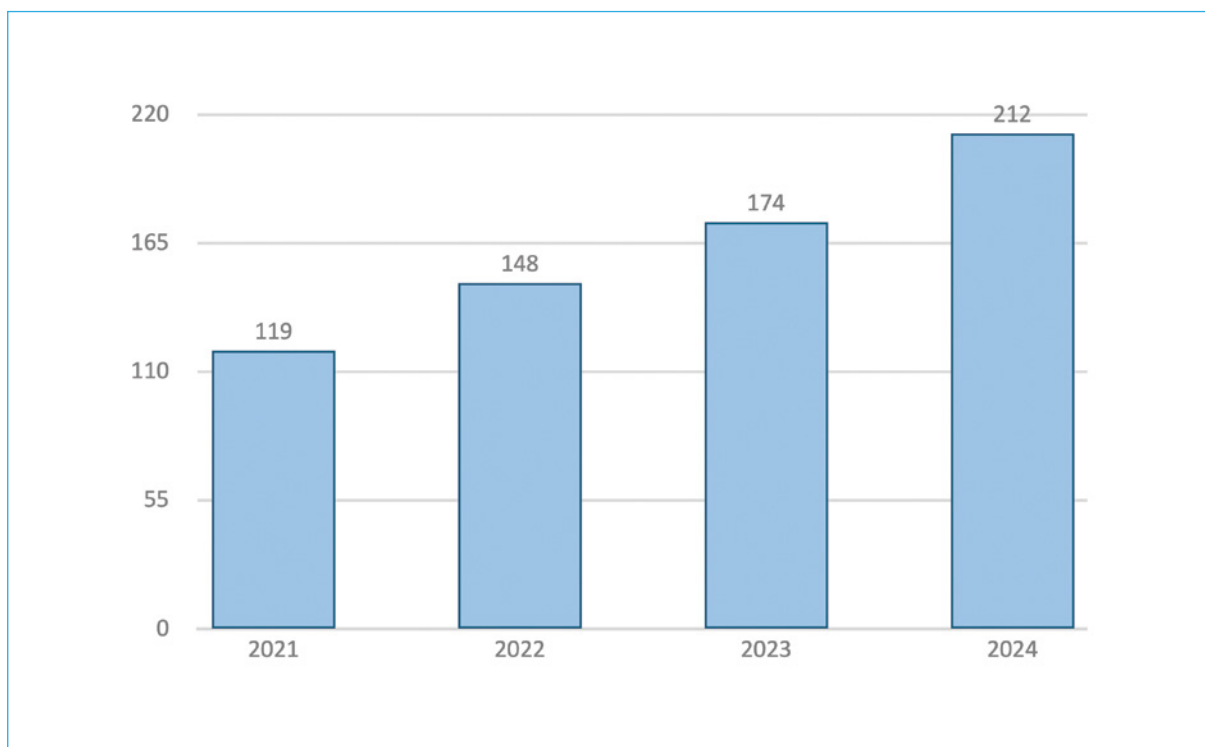
The application of radiation processing in the water treatment field has achieved remarkable results. Domestic industrial-scale demonstration projects for the treatment of printing and dyeing wastewater by electron accelerator radiation have been operating stably for many years, and a 30,000-ton commercial project for industrial wastewater treatment by electron beams has also been put into operation. By the end of 2024, the designed capacity of electron beam-based wastewater treatment in China had reached 40,400 cubic meters per day.

### 3. Radiation Processing Market Trends

Many users have turned their attention to electron accelerator irradiation devices due to some operational advantages and some challenges to the international  $^{60}\text{Co}$  supply chain. 10MeV electron accelerators for radiation processing have the characteristics of low investment, small floor space, and quick commissioning. In recent years, there has been a step increase in 10MeV electron accelerators used for medical device sterilisation and food processing.

As of the end of 2024, among the accelerators for radiation processing nationwide, there are approximately 212 10MeV electron accelerators with a total power of approximately 4,278 kW, mainly used for medical device sterilisation and food processing. The growth trend in recent years is shown in Figure 5.

**Figure 5:** Growth Trend of 10MeV Electron Accelerator in China



Some  $^{60}\text{Co}$  source irradiation service providers have newly selected 10 MeV electron accelerator irradiation devices when source procurement is unavailable or too costly; some newly launched irradiation service providers directly choose 10 MeV electron accelerator irradiation devices.

10MeV electron accelerators are boosting the radiation processing of characteristic agricultural products. In recent years, the application of radiation processing technology in characteristic agricultural products is emerging, with layouts in regions where there were previously no accelerators, such as Ningxia, Gansu, and Xinjiang.

It is worth mentioning that the project of "Construction of Plateau Tibetan Medicine Irradiation Sterilization Technology and Engineering Center" in the Tibet Autonomous Region is being jointly implemented by Jiangsu Shenhou Pharmaceutical Research Co., Ltd. and several other units. The project uses electron accelerator irradiation to sterilise Tibetan medicinal materials and Tibetan patent medicines. Compared with traditional sterilisation processes such as moist heat, dry heat, and microwave, it has the advantages of low temperature, high penetration, high efficiency, low cost, and no pollution. At present, research on the irradiation sterilisation process of Tibetan medicinal materials such as Rhododendron anthopogonoides, saffron, Ligadou, and nutmeg, as well as Tibetan patent medicines such as Shisanwei Ximing Pills, Feire Puqing Powder, Shiliuwei Rhododendron Pills, and Sanwei Tanxiang Decoction Powder, has been carried out.

The Plateau Tibetan Medicine Irradiation Sterilization Engineering Technology Center project is under construction. The project is designed to use a 10MeV electron accelerator source for processing Tibetan medicine products, and is expected to be officially put into use in 2026.

With the increasing application demands for food safety and sterilisation of medical and health supplies, the market scale of 10MeV industrial electron irradiation accelerators is continuously expanding. Except for Qinghai, Guizhou, and Inner Mongolia Autonomous Region, they are distributed in all other provinces and cities on the Chinese mainland. Shandong Province ranks first in the number of devices, and within Shandong Province, Qingdao, Yantai, and Weihai have the largest number.

## 4. Overview of Public Enterprises

| Number | Enterprise  | Stock Code            | Website   |
|--------|---|-----------------------|---|
| 1      | China Isotope and Radiation Corporation                     | 01763.HK              | <a href="https://www.circ.com.cn/">https://www.circ.com.cn/</a>               |
| 2      | CGN Nuclear Technology Development Corporation              | 000881.SZ             | <a href="http://www.cgnnt.com.cn/">http://www.cgnnt.com.cn/</a>               |
| 3      | Zhongjin Irradiation Corporation                            | 300962.SZ             | <a href="https://zjfz.chinagoldgroup.com">https://zjfz.chinagoldgroup.com</a> |
| 4      | Shenzhen Woer Heat-Shrinkable Material Corporation          | 002130.SZ<br>09981.HK | <a href="http://www.woerpower.com">http://www.woerpower.com</a>               |
| 5      | Hubei Xiangyuan New Material Technology Corporation         | 300980.SZ             | <a href="https://www.hbxyc.com/">https://www.hbxyc.com/</a>                   |
| 6      | Beijing Hongyisifang Radiation Technology Corporation       | 430119.NQ             | <a href="http://hysf.com.cn">http://hysf.com.cn</a>                           |
| 7      | Shandong Vanform High Energy Physics Technology Corporation | 834428.NQ             | <a href="https://vanform.com">https://vanform.com</a>                         |
| 8      | Tongweixinda Technology (Jiangsu) Corporation               | 874144.NQ             | <a href="http://www.tongweixinda.com/">http://www.tongweixinda.com/</a>       |



## 5. International Cooperation

### **The 3rd International Food Ionizing Processing Symposium Successfully Held in Chengdu, Sichuan to Promote the New Development of the Global Food Industry Empowered by Irradiation Technology**

From June 4 to 6, 2025, the 3rd International Food Ionizing Processing Symposium (IFIS), hosted by the China Isotope & Radiation Association, was held in Chengdu. This grand event brought together more than 200 experts and representatives from industries, enterprises, government departments, and scientific research institutions in 25 countries, including China, Austria, Belgium, France, Portugal, Canada, Australia, South Korea, India, Brazil, Argentina, Mexico, Vietnam, and the Philippines. They jointly discussed the development trends of international food irradiation processing, deepened global exchanges and cooperation, and promoted the innovative application of cutting-edge technologies, including radiation technology and intelligent processing, in the food industry.

**Figure 6:** IFIS2025 in Chengdu China (Photo provided by CIRA)



During the symposium, representatives from various countries focused on the innovation and international cooperation of irradiation technology in the food field, through special seminars, roundtable discussions, and sharing experience and case studies. Particular attention was paid to the use of advanced food irradiation technology to improve food safety, extend shelf life, reduce losses, and meet increasingly stringent international quarantine requirements. In-depth exchanges were conducted on topics such as the current development status of food irradiation technology in various countries, the global regulatory framework for food irradiation, the coordination and unification of standards and regulations, the application of intelligent equipment in the irradiation industry chain, the improvement of consumer and public awareness, and the application practices of food irradiation and phytosanitary treatment, jointly depicting the future blueprint for the development of food irradiation technology.



## 6. Conclusion

Shan Zhongde, Director of the China Atomic Energy Authority, pointed out that efforts should be made to promote the wide application of nuclear technology in industry, agriculture, biology, medical and health care, ecological and environmental protection, and other fields. The importance of maximising the potential of an effective market and a promising government; strengthening top-level design and path planning; encouraging enterprises, social capital, etc. to participate in the development of the nuclear technology application industry; the importance of promoting integrated development, continuous industrial scale expansion; and providing strong support for serving the national economy, people's livelihood and enhancing people's well-being; were all highlighted.

The development and progress of China's radiation processing field are inseparable from the strong support of Chinese government agencies at all levels, as well as the strong support and help of international organizations such as the IAEA and iia. Let us work together to make nuclear technology boost economic development and make greater contributions to promoting the people's ever-growing needs for a better life.

### About China Isotope & Radiation Association (CIRA)

The China Isotope & Radiation Association (CIRA) is a national and industrial social organization voluntarily formed by enterprises, institutions, and individuals in the isotope and radiation industry and related industries, and is a non-profit social organization.

The purpose of the association is to actively promote the development and technological progress of the industry, safeguard the legitimate rights and interests of the entire industry and its members, revitalize China's isotope and radiation cause, and promote the country's socialist modernisation drive.

For more information, please visit the [CIRA website](#).

### About the International Irradiation Association (iia)

The iia is a not-for-profit organization that supports the global irradiation industry and scientific community. The core objective of the Association is to support its members in advancing the safe and beneficial uses of irradiation. Communication, Education and Advocacy are key functions performed by the iia for its members and the wider irradiation community. The iia has forged partnerships with regional, national and irradiation technology and application specific organisations whose aims are aligned with those of the iia. We believe that we can achieve more by working together.

For more information, please visit the [iia website](#).



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