



Key technologies and series product inventions of graphene-based anti-infective precision interventional devices

Project Personnel : Lichun ZHAO, Dewen LIU, Yuting YANG, Yuping LI

Organization : Guizhou University of Traditional Chinese Medicine;
Experimental Research Center, China Academy of Chinese Medical Sciences



Key technologies and series product inventions of graphene-based anti-infective precision interventional devices

Innovative achievements covered by 10 nationally authorized patents



Graphene Oxide Thrombus Removal Shield Needle System



Graphene Hair Follicle Physiotherapy Needle



Graphene Oxide Cardiovascular Stent System



Graphene Laparoscope



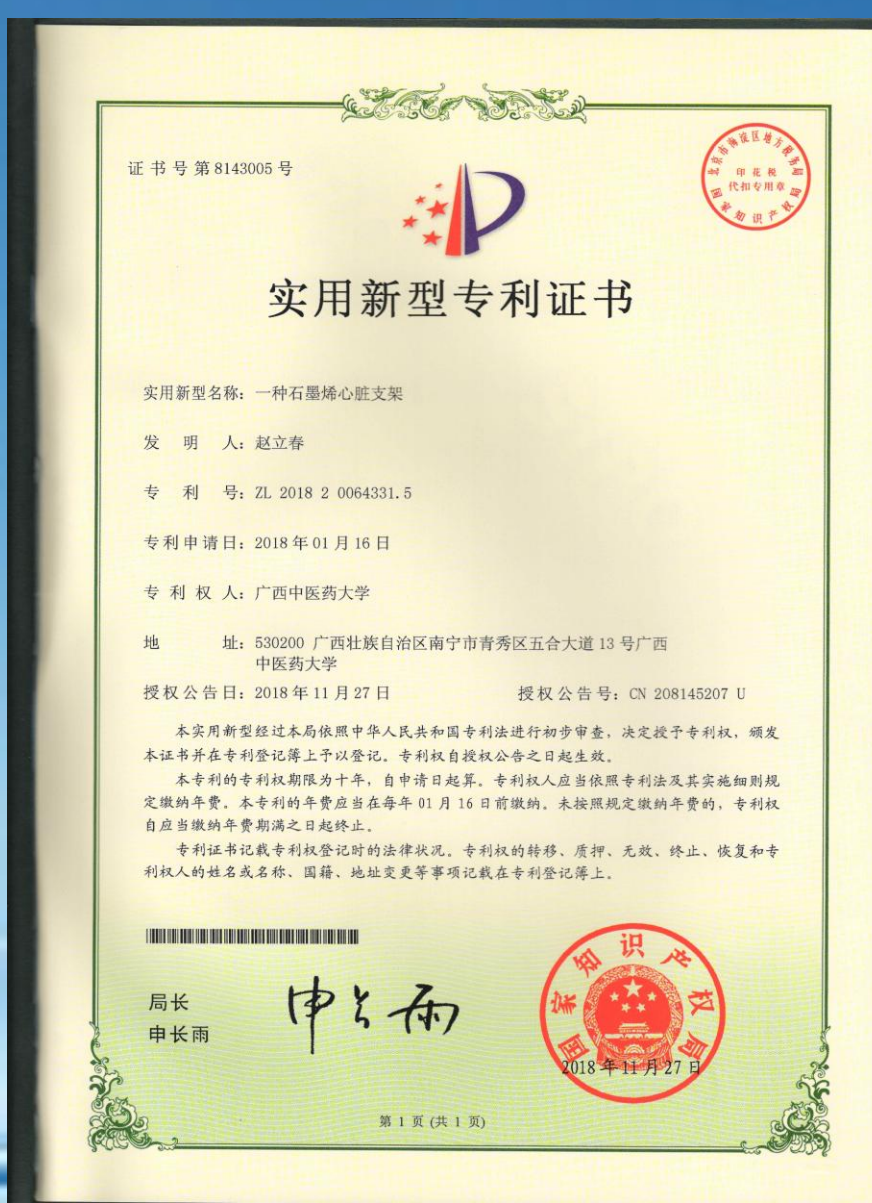
Graphene Drug Delivery Device



Novel Tunneling Needle



Graphene Acupuncture Needle



Graphene Cardiovascular Stent



Graphene Physiotherapy Wave Chamber



Topical Drug Delivery Device:



Research Background

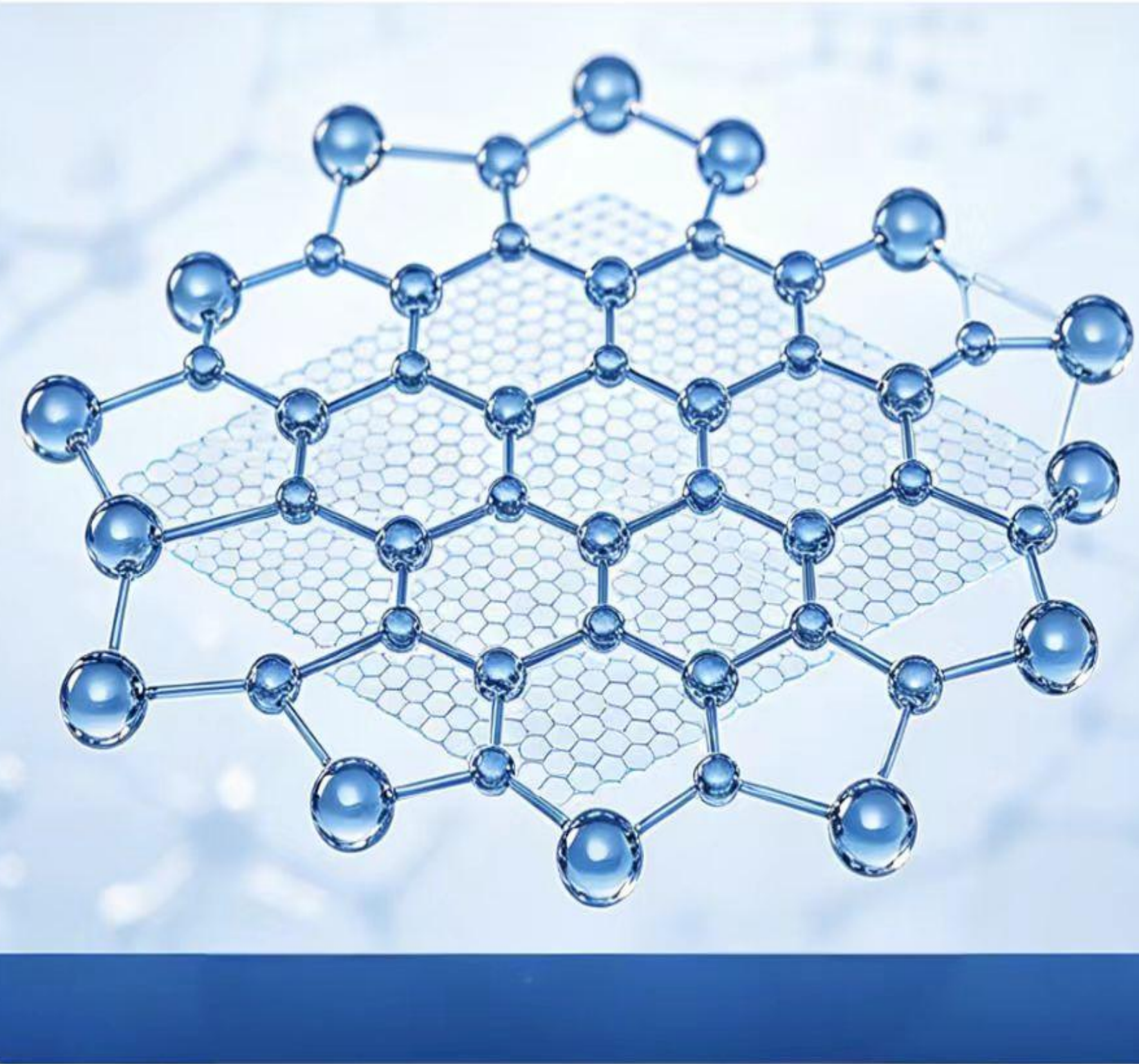
The world's thinnest and hardest nanomaterial

Almost completely transparent

In-plane superlubricity characteristics

Graphene possesses a perfect two-dimensional crystal structure and is known as the thinnest and hardest nanomaterial in the world. It is almost completely transparent, and its in-plane friction properties exhibit superlubricity.

Properties of Graphene Oxide and Medical Device Applications



Antibacterial and antimicrobial properties



Biocompatibility



Electrical and thermal conductivity



Anti-infection + precision intervention
Highlighting and overcoming pain points of traditional medical devices

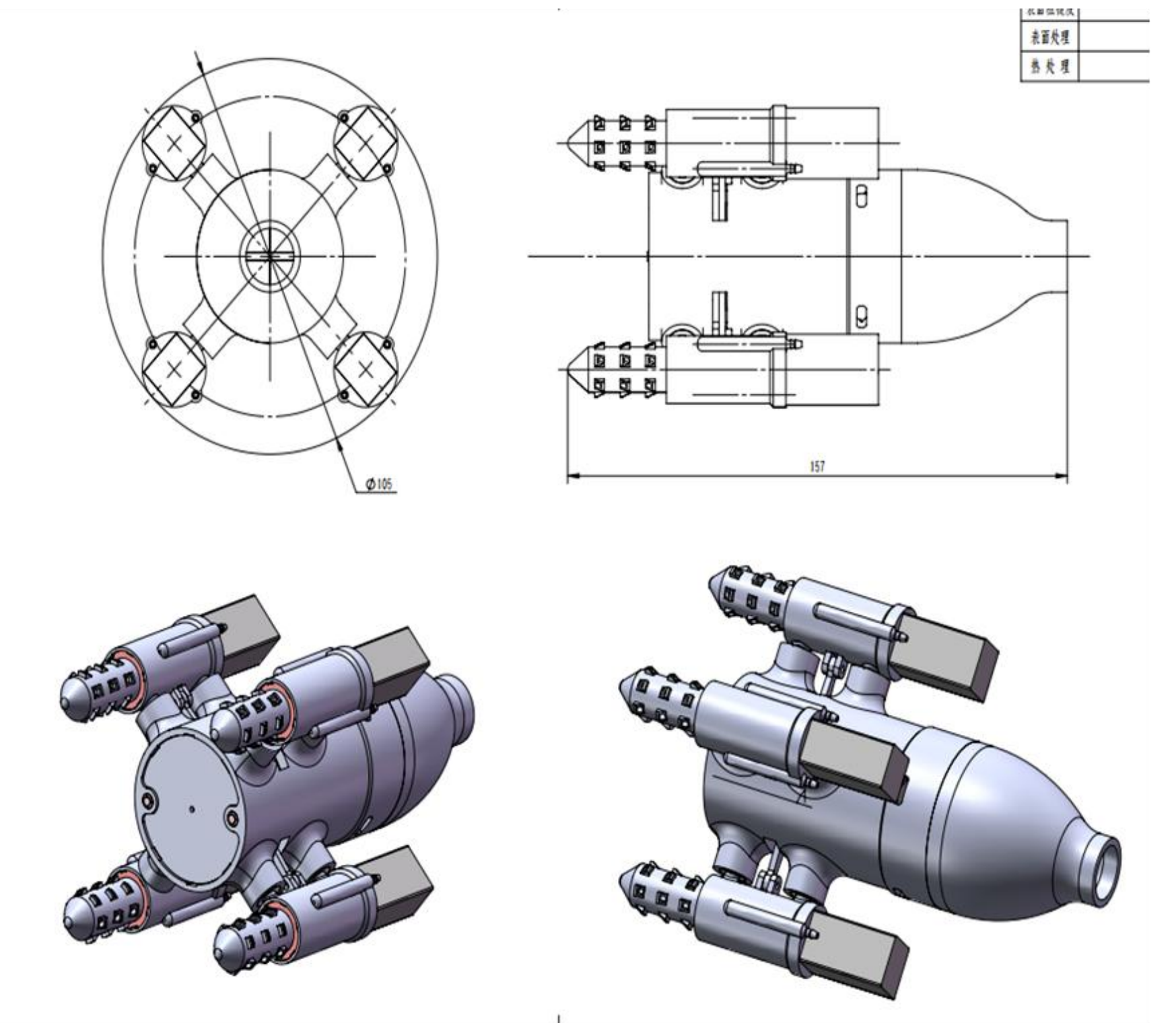
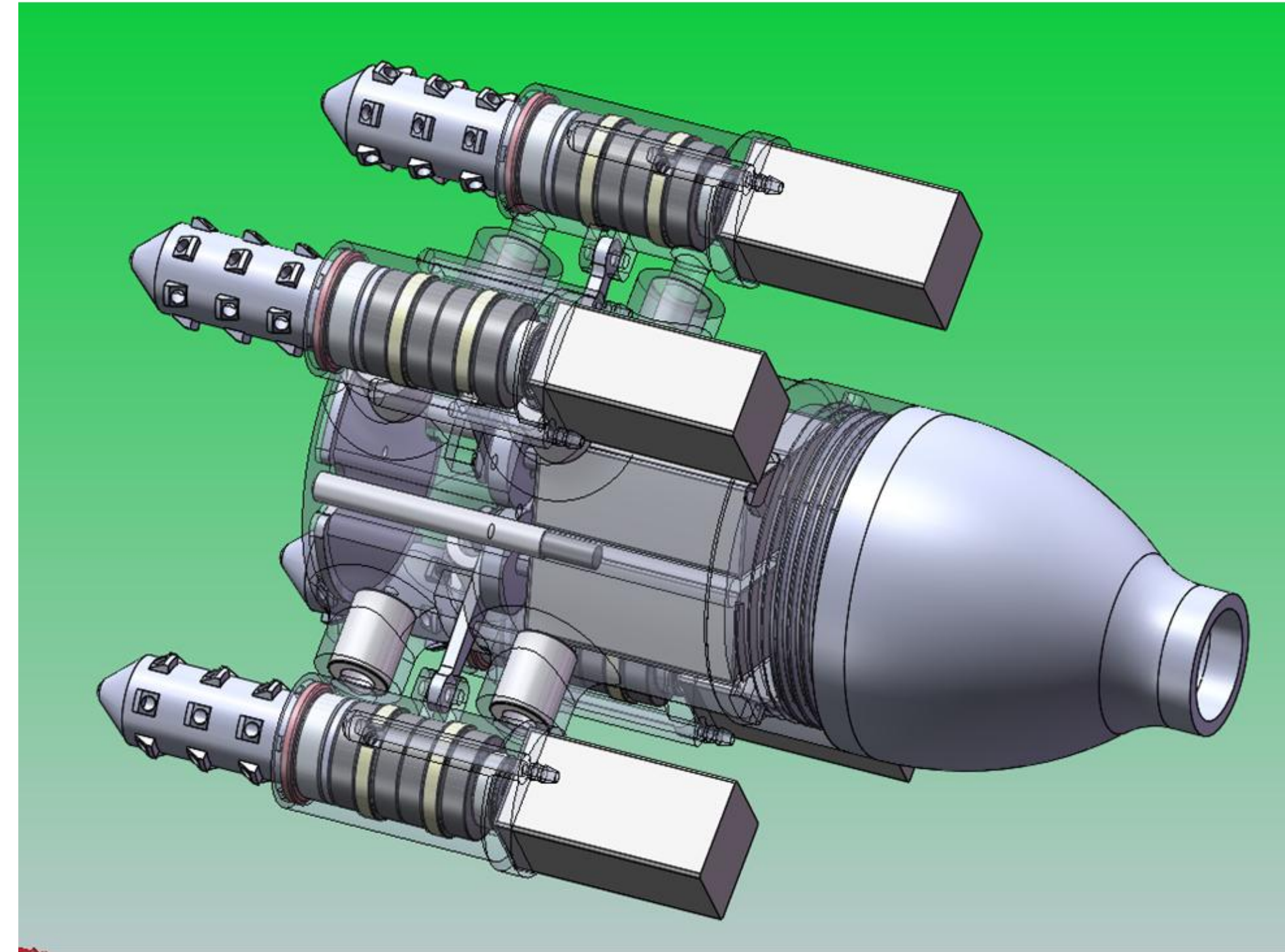


Research Achievement

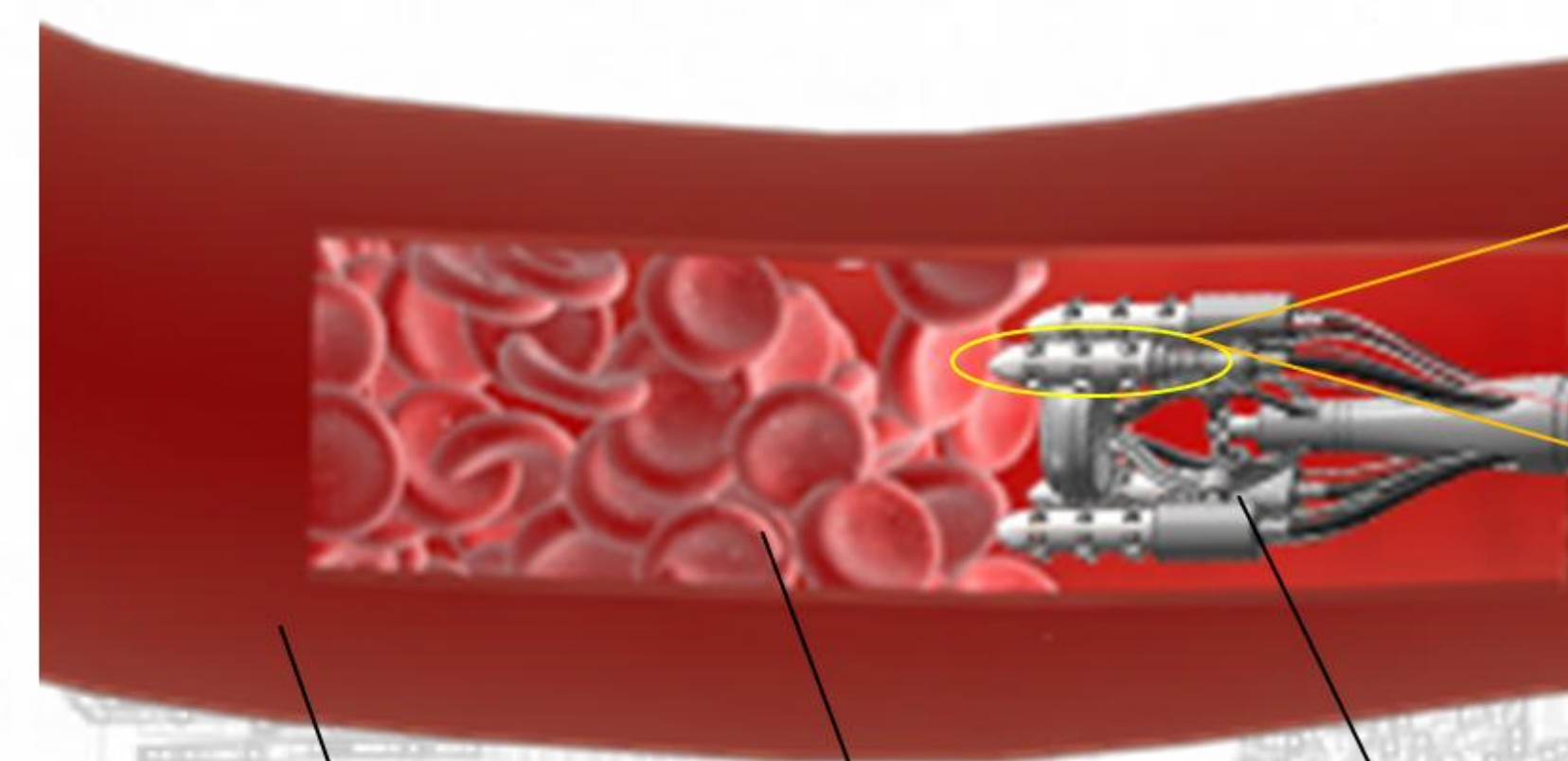
Graphene Oxide Thrombus Removal Shield Needle System

It enables minimally invasive visualization, precise thrombus removal, and controlled release of thrombolytic drugs, thereby preventing secondary embolism and intraoperative infection. The product is equipped with a high-definition camera and a laser measurement device, allowing operators to observe the internal situation via a display screen.

3D diagram of the shield needle model



Schematic diagram of the product within a blood vessel

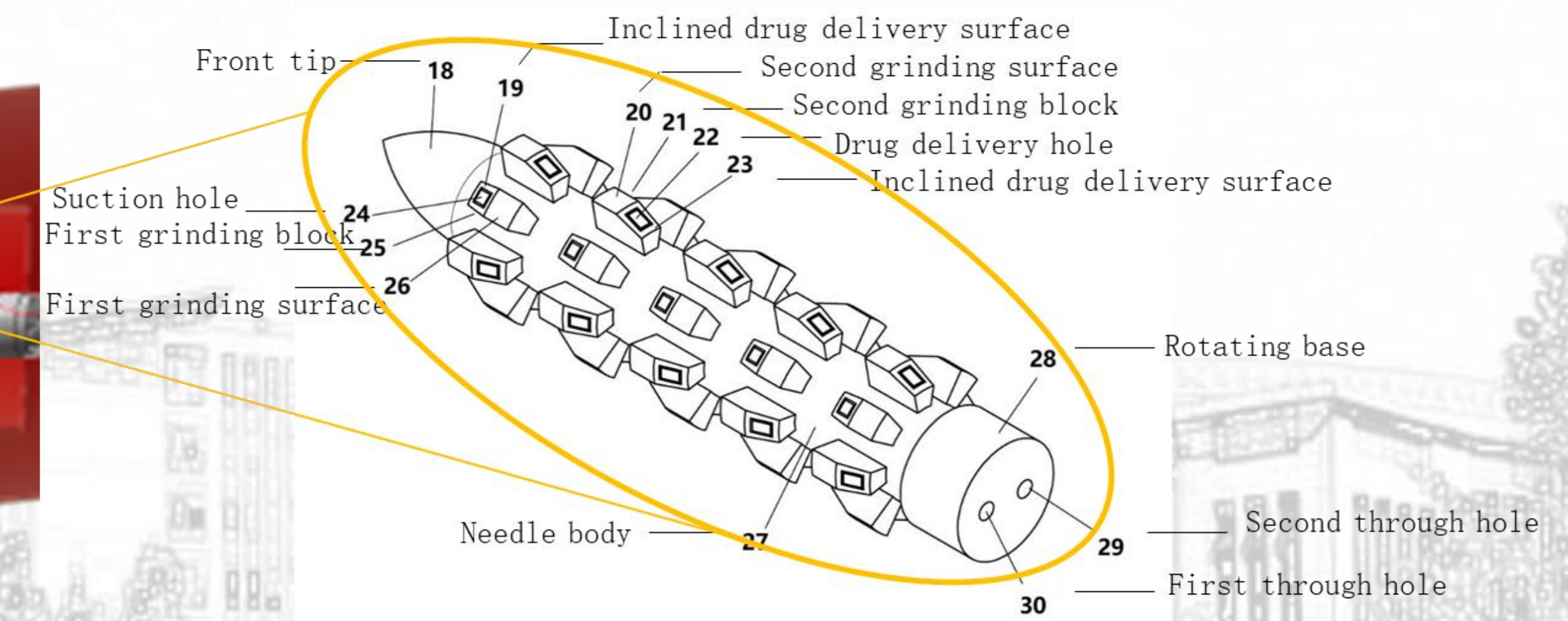


Blood vessel

Thrombus

Shield needle

Enlarged schematic diagram of the self-rotating needle tip structure

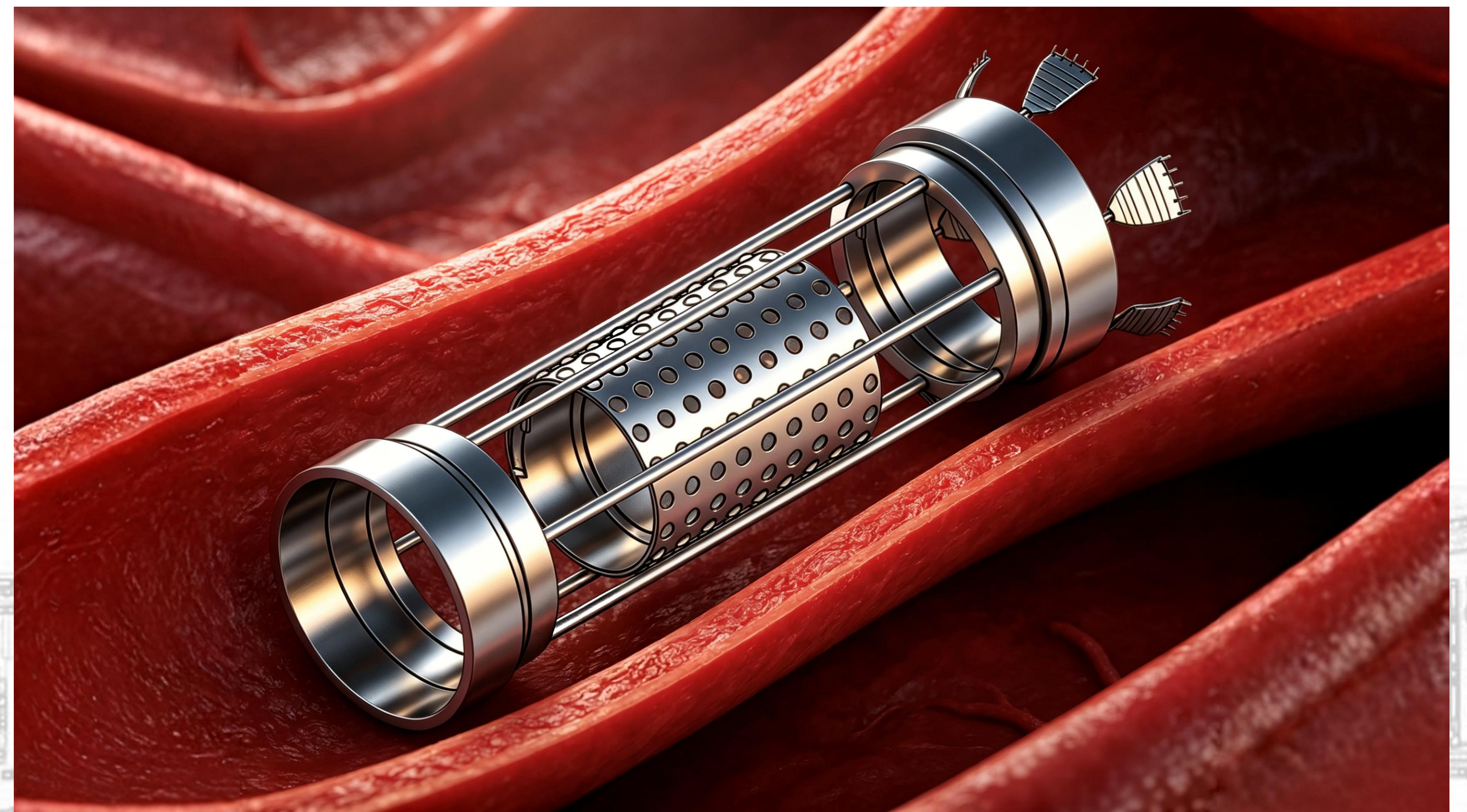
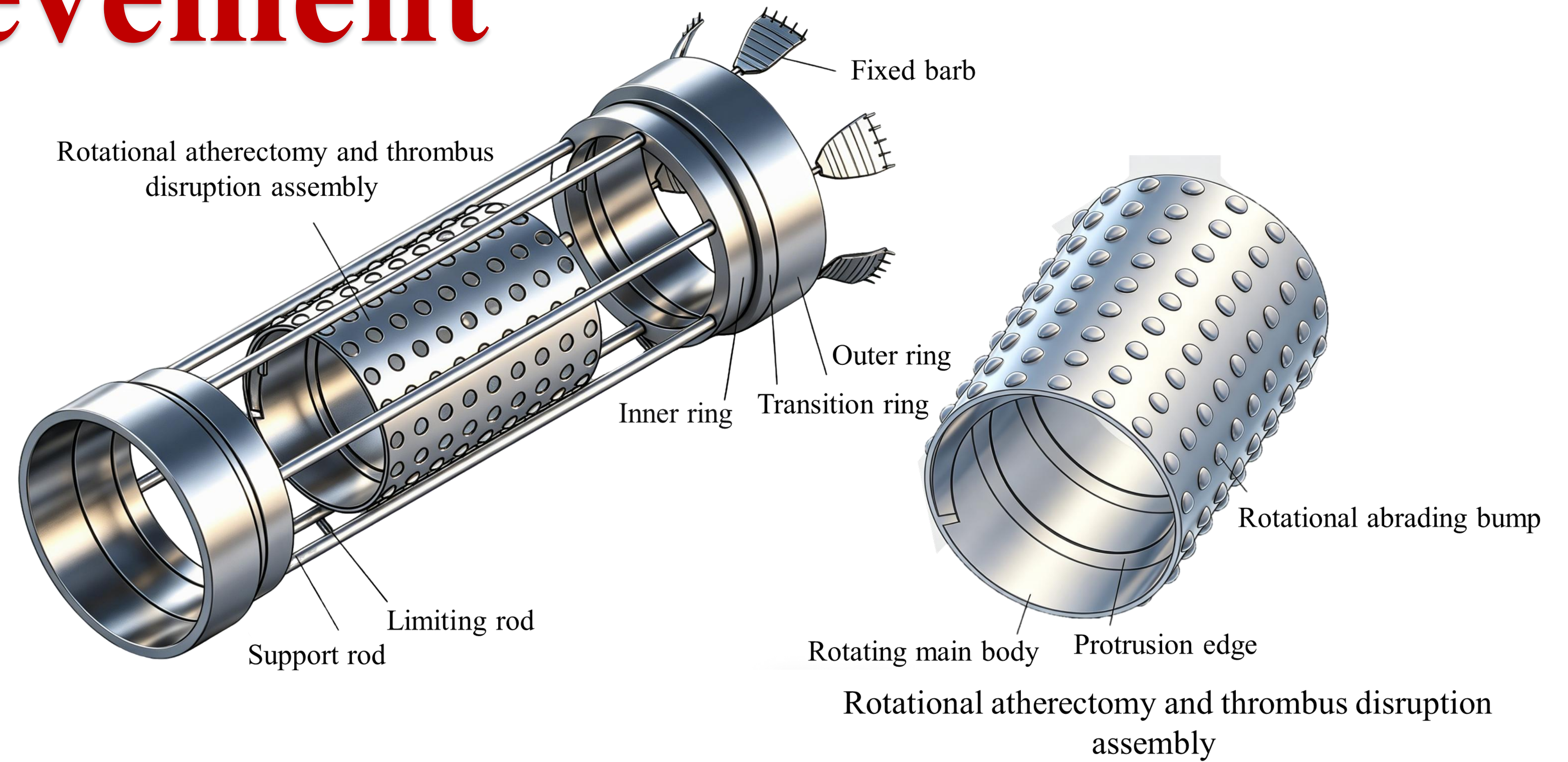




Research Achievement

Graphene Oxide Cardiovascular Stent System

While providing vascular support, it can break small thrombi, inhibit vascular proliferation, and exert antibacterial and antimicrobial effects, thereby significantly reducing the risk of post-operative restenosis and infection.

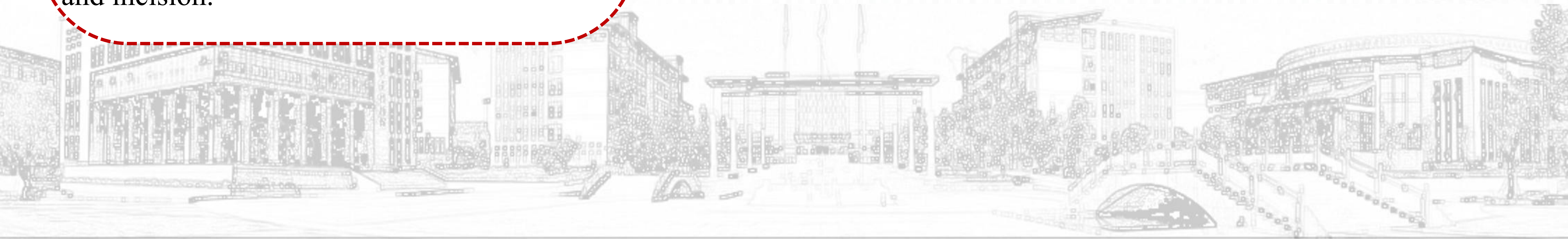
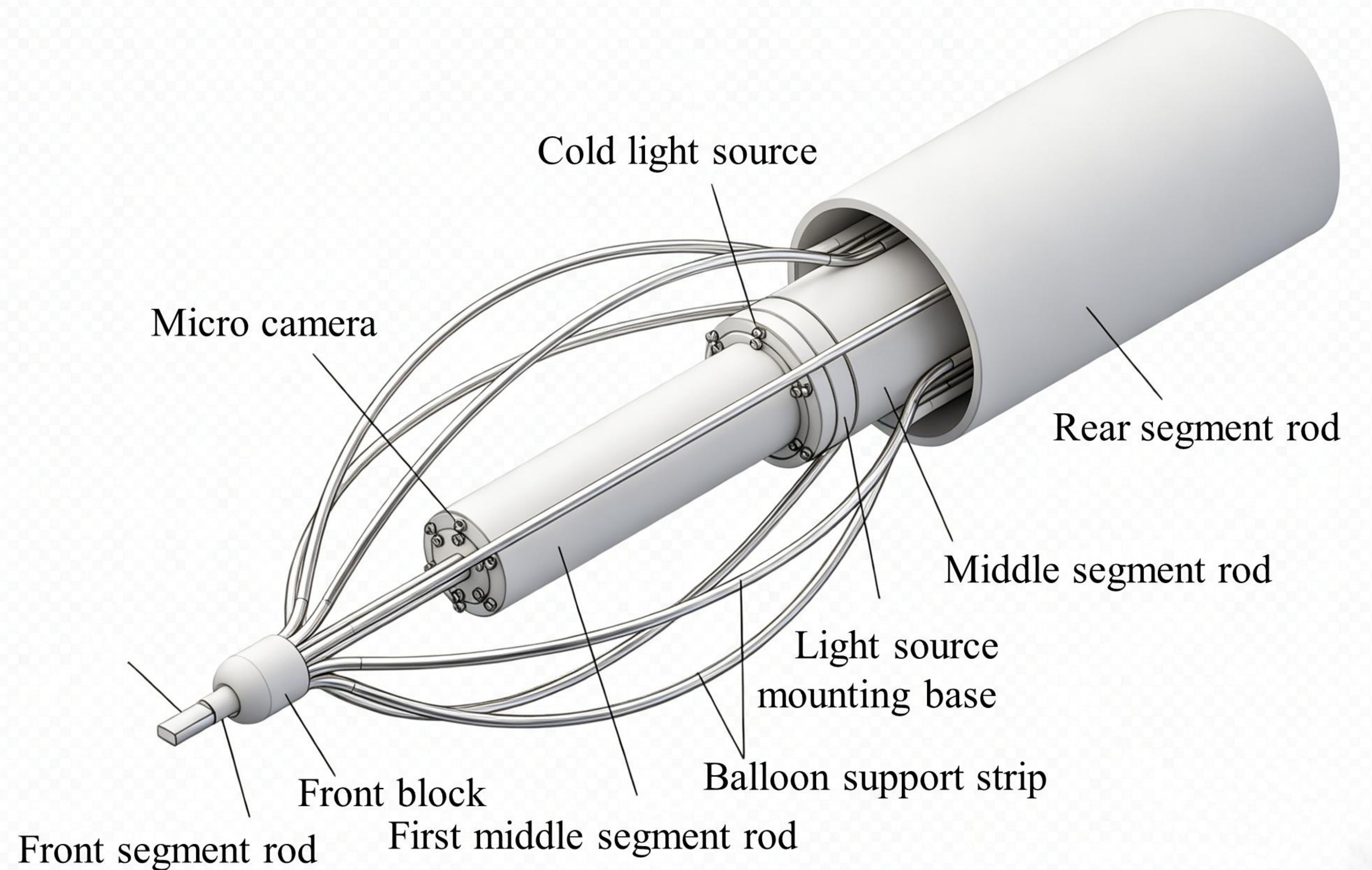




Research Achievement

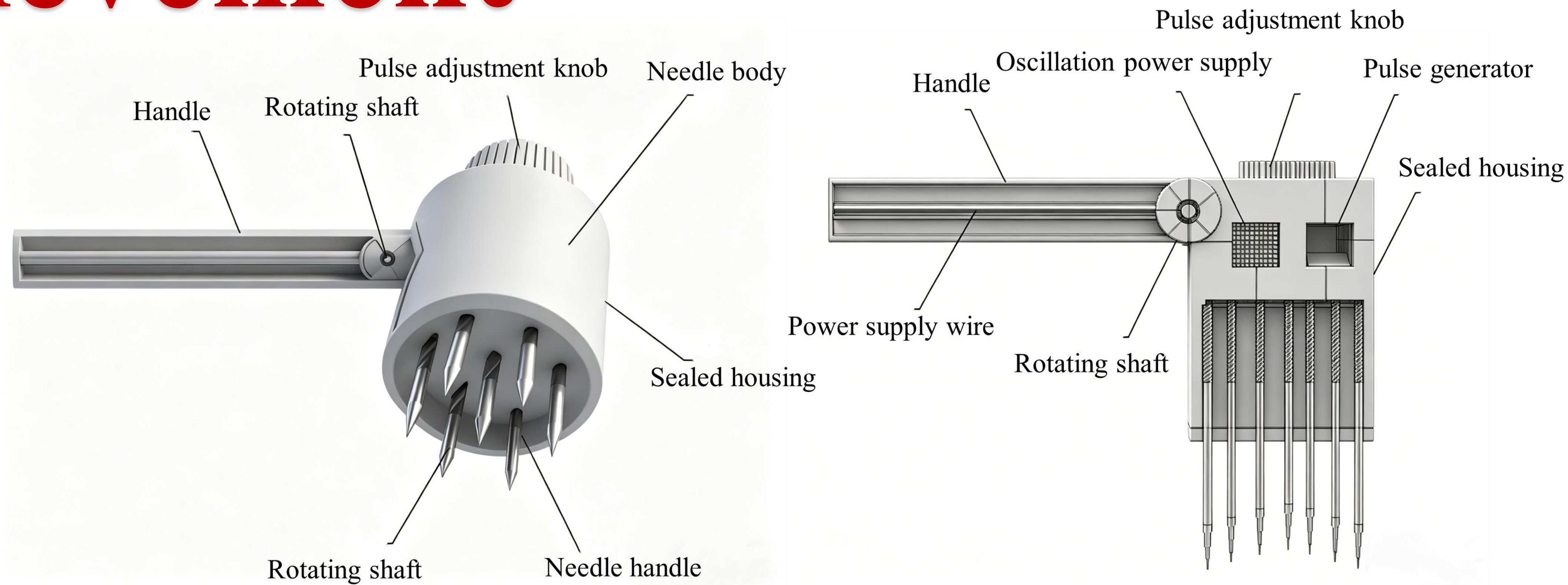
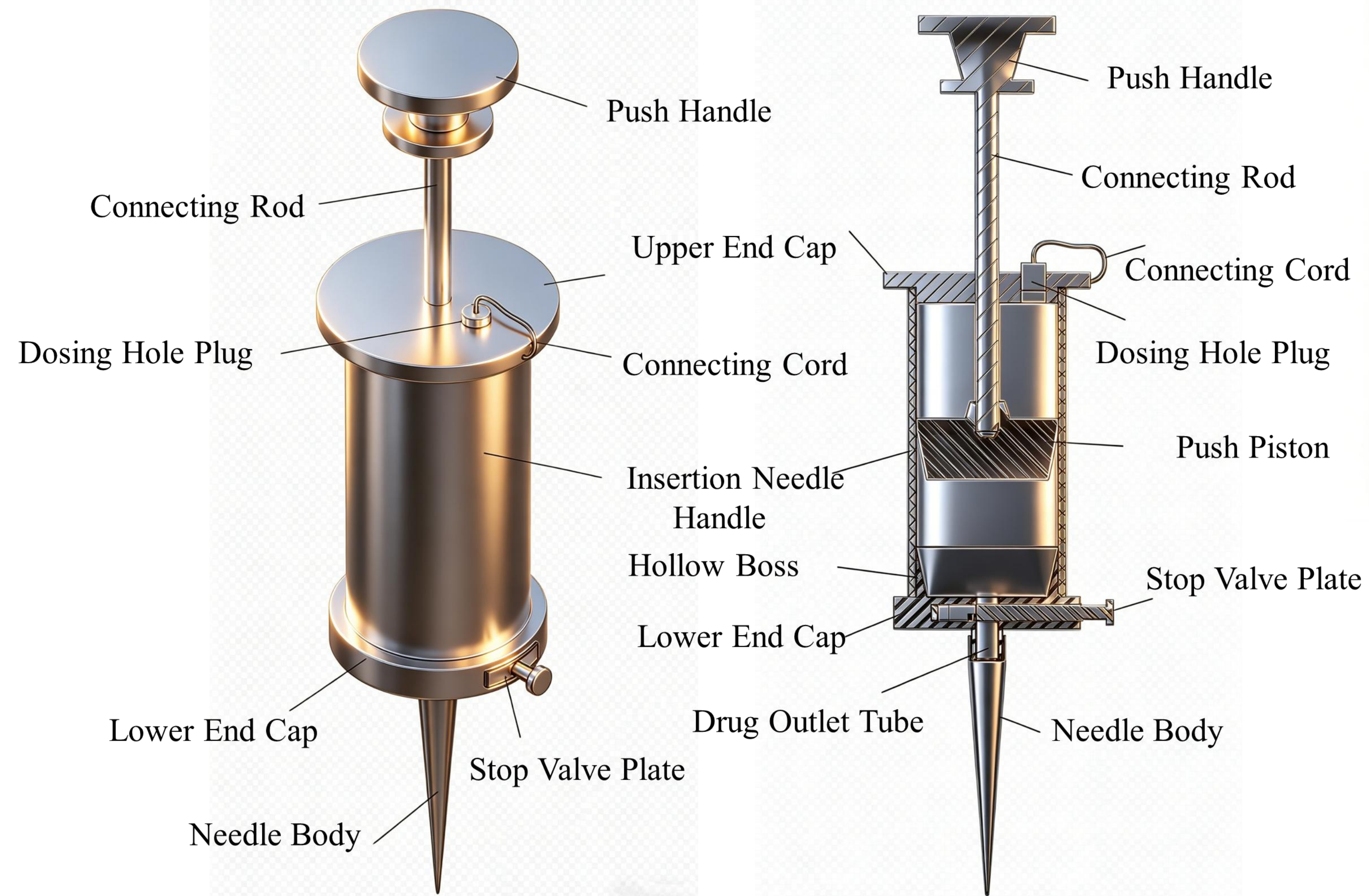
Graphene Laparoscope

It allows surgical operations to be performed without the need for CO₂ pneumoperitoneum, requiring only a single surgical incision. Due to the use of graphene materials, it effectively achieves sterilization and antibacterial effects, preventing bacterial infection and inflammation at the surgical site and incision.





Research Achievement



SEM schematic diagram of the tip modification of the graphene follicular physiotherapy needle

Graphene Acupuncture Needle

It enables "needle-drug synergy" and simultaneously utilizes the thermoelectric effect of the graphene composite material to achieve effective anti-inflammatory action, improve the therapeutic effect of acupuncture physiotherapy, and reduce the risk of interventional infection.

Graphene Hair Follicle Physiotherapy Needle

A graphene film layer is deposited on the surface of the needle tip structure. When electrically energized, the graphene film layer emits far-infrared waves in the range of 8–15 μm, thereby preventing hair follicle atrophy, promoting blood circulation and hair growth, and effectively enhancing scalp comfort.



Research Achievement

Graphene Drug Delivery Device and Topical Drug Delivery Device

It enables intelligent and precise drug delivery. By combining the permeation-enhancing and antibacterial properties of graphene, it reduces wound infection and achieves precision in external care.

Traditional Problems

✗

Uneven application, difficult dosage control

Drug waste

High dependence on manual operation

Intelligent Precision Drug Applicator

Intelligent Controller
Automatic detection, intelligent decision-making

Rotating and Pushing Mechanism
Quantitative release
Uniform coating

Multi-Chamber Drug Storage System
On-demand switching

Uniform coating

Graphene "Physical Penetration Enhancement" Synergy

Far-infrared thermal effect

Improves local microcirculation

Promotes transdermal absorption

Applications and Potential

Skin disease treatment

Burn care **Wound care**

Standardized and precise medication use

Good prospects for promotion and industrialization

ZL201910335160.4 ZL201910335157.2


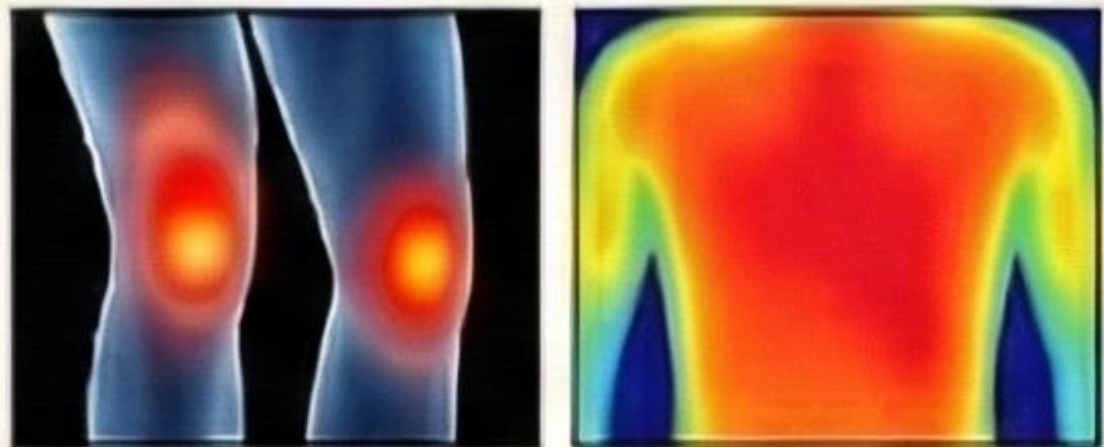


Research Achievement

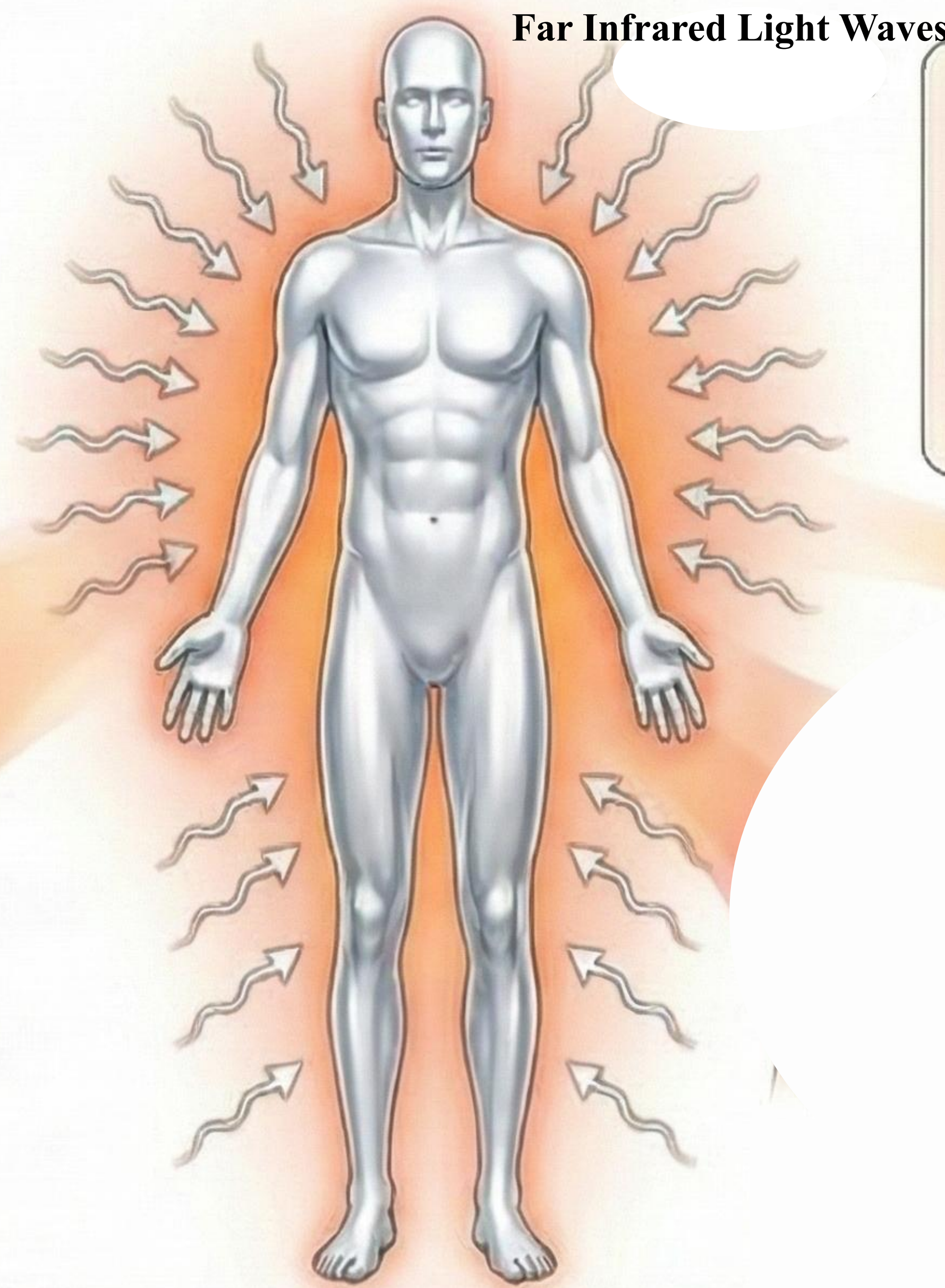
Graphene Physiotherapy Wave Chamber

Leveraging the high-efficiency far-infrared absorption and directional radiation characteristics of graphene, it achieves large-area, controllable constant-temperature far-infrared physiotherapy. This product has obtained a Class II medical device registration certificate in China (No. 20212090236) and has completed a multicenter randomized controlled clinical trial involving 128 cases of knee osteoarthritis, with a clinical improvement efficacy rate of 98.24%.

Key Features

Large area / uniform thermal field



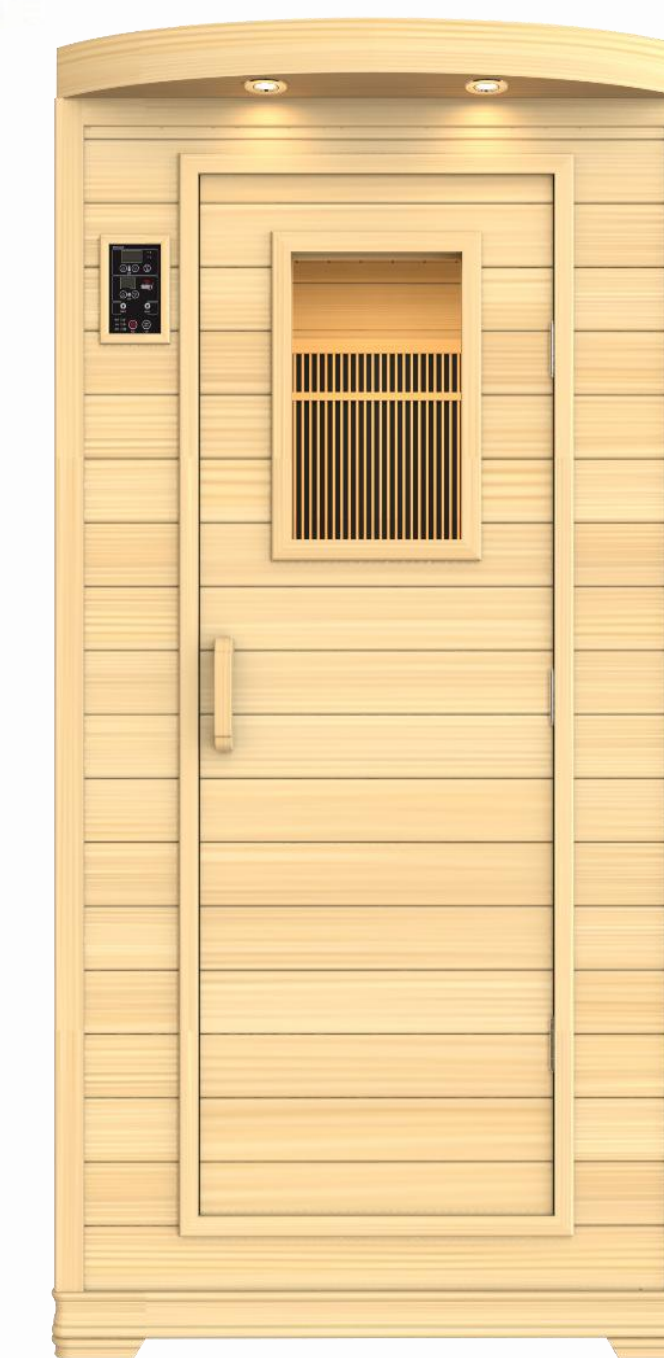

Mild and controllable



Safety
Class II medical device registration



Graphene Physiotherapy Wave Room
Whole body hyperthermia



Applications and Achievements



Clinical validation:

Adjuvant treatment for knee osteoarthritis (excellent analgesic effect)

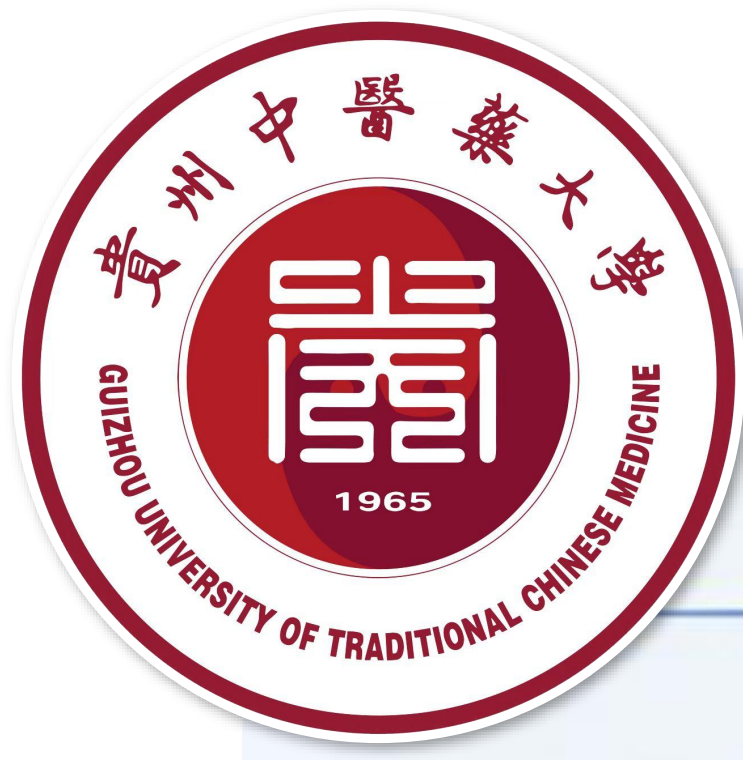


Intellectual property:

1 nationally authorized patent



Industrialization: Guangxi Xi Nuan New Material Technology Co., Ltd. (demonstration project)



Innovations

Full-Chain Technological System Innovation Achievements

Technological Breakthroughs

- Fills multiple industry gaps
- Fully covers the technical features of 10 patents

Industrial Impact

- Drives development of industrial
- Reduces patients' medical burden and infection risk



Industry Promotion

Domestic production of anti-infective precision interventional medical devices



Modernization of traditional Chinese medicine



Technological innovation in minimally invasive surgery



Thanks!

Project Personnel : Lichun ZHAO, Dewen LIU, Yuting YANG, Yuping LI

Organization : Guizhou University of Traditional Chinese Medicine;
Experimental Research Center, China Academy of Chinese Medical Sciences