

MEDICAL & PATIENT WARMING

Medical Thermal Management Solution

CNT flexible heating for operating table mattresses, patient warming blankets and localised body warming.

- ± 1 °C precision temperature control for clinical warming
- 24 V and below — patient-safe low-voltage architecture
- Fully washable and disinfectable; 40 standard wash cycles

FlexTherm · Shanghai Burning New Material Co., Ltd.

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01 CORE MATERIAL

Carbon Nanotube Heating Film

CNT heating film is a self-assembled network structure formed from freely arranged carbon nanotube arrays. It combines excellent mechanical, electrical and thermal performance with high chemical stability, and is one of the most promising energy-saving heating materials available for industrial adoption today.

99.5%**Electro-thermal conversion**

Electrical energy converted into usable heat

1.35 g/cm³**Ultra-low film density**

Average film thickness of only 5 μm

3500 W/m·K**Thermal conductivity**

Very low heat capacity: instant on, instant off

0.89**Normal total emissivity**

Strong far-infrared radiation characteristics

60%+**Thermal radiation ratio**

Higher usable heat output per watt

±1 °C**Temperature accuracy**

NTC sensing plus proprietary control algorithm

Surface heating, not line heating

Conventional resistance wire heats along a line, producing hot spots and cold gaps. CNT film heats across its entire surface, so heat distribution is even, controllable and repeatable across large or irregular areas.

02 SYSTEM ARCHITECTURE

CNT Flexible Thermal Management System

Encapsulation fabric > CNT heating film > FPC circuit > NTC sensor > Encapsulation fabric

Ultra-thin and fully flexible The extremely high aspect ratio of carbon nanotubes forms a self-assembling film network. It can be bent, folded and crumpled freely, solving the poor flexibility and poor surface contact of conventional heating pads.	Fast, even heating Surface temperature rises to the set point within seconds. The film emits far-infrared radiation in the 6–14 μm band, which penetrates directly into the target medium rather than only warming its surface.
Safe by design Powered from 3.7 V / 5 V / 7.4 V / 12 V / 24 V low-voltage inputs, far below the 36 V human safety limit. Multi-layer protection covers over-current, short circuit and open circuit.	Intelligent temperature control In-house hardware and control-algorithm development enables multi-level precision control, with heating profiles tuned to each customer's temperature and timing requirements.
Machine washable The film's resistance to repeated folding supports 40 standard wash cycles. FlexTherm heating assemblies carry a high waterproof rating and retain full performance after washing.	Instant heat-up, precise holding Sheet resistance is very low and extremely uniform, so heat-up is immediate at minimal power draw. Patch NTC sensors bonded to the film deliver ±1 °C control accuracy.

Verified heat-up curve

With the highest level set to 53 °C, surface temperature exceeds 55 °C within one minute, then enters holding mode and stabilises at approximately 53 °C. The difference between the two measurement points stays within 1 °C.

03 APPLICATION CONTEXT

Why Flexible Heaters Are Ideal for Medical Devices

A flexible heater fits any device. Medical heating elements can be customised to the exact specification of the equipment they serve — shape, heating area, voltage, temperature profile and control logic — instead of forcing the device design to accommodate a rigid heater.

Carbon nanotube heating film is 0.05–0.1 mm thin, bends and folds freely, and heats as a surface rather than a wire. That combination makes it suitable for equipment in direct or near-direct contact with the patient, where even temperature and safety margins matter most.

Customisable to the exact specification

Heating film layout, flexible electrode routing, NTC sensor placement, control board and firmware are all developed around the device geometry, so the heater becomes part of the product rather than an add-on.

04 SOLUTION OVERVIEW

Medical Thermal Management Product Range

Three core patient-warming applications are covered by the same CNT thermal management platform.

Operating table heating mattress A surface-heating mattress layer for the operating table, maintaining patient temperature throughout the procedure without bulky tubing or air hoses.	Body warming blanket A soft, flexible warming blanket for surface rewarming, thin enough to drape naturally over the patient.
Localised body heating Wraps and pads for targeted warming of a limb or body region, shaped to the treatment area.	Device-integrated heating Custom heating modules built into medical equipment where a defined, stable temperature is required.

05 SAFETY

Low-Voltage Supply Protects Patient Health

Every medical heating system is powered at 24 V or below — far under the 36 V human safety voltage threshold. Electrical risk is removed at the source rather than managed after the fact.

≤ 24 V Supply voltage All medical heating equipment operates at 24 V or below	< 36 V Human safety limit System voltage stays well inside the safe range	Multi-layer Circuit protection Over-current, over-temperature and abnormality protection
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- Over-current protection cuts supply before the circuit can be stressed.
- Abnormal-temperature protection stops heating if the measured temperature leaves the safe band.
- Leakage and electric-shock hazards are eliminated fundamentally by the low-voltage architecture.

06 CONTROL ACCURACY

±1 °C Precision Temperature Control

Clinical warming demands a narrow temperature band. Adults typically require warming to 37–40 °C, while infants and small children require 36–38 °C — a requirement that leaves little tolerance for temperature drift.

±1 °C Control accuracy Achieved control precision of the heating module	37–40 °C Adult warming Typical adult warming temperature band	36–38 °C Infant warming Typical infant and paediatric warming band
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Why precision matters clinically

A precise control module combined with stable surface heating reduces the burn and over-heating risks associated with existing medical warming devices, including heat-stroke conditions caused by excessive warming.

Heat-up behaviour versus other heating materials

Time (min)	CNT film (relative)	Resistance wire	Carbon crystal panel
1	85	60	70
3	92	82	78
5	95	92	79
7	97	97	77
10	100	100	68

Reading the curve

CNT film reaches its working level fastest and then holds it. The carbon crystal panel peaks early and then falls away, while resistance wire needs significantly longer to catch up — with wire heating, heat is delivered along a line rather than across a surface.

07 OPERATIONS

Convenient, Hygienic and Environmentally Sound

The heating system can be fully washed and disinfected. That removes the need for single-use warming devices, keeps the equipment thoroughly clean between patients, prevents cross-infection, and cuts the cost of repeated purchasing.

Washable and disinfectable Complete washing and disinfection between uses; the CNT heating assembly withstands 40 standard machine wash cycles without loss of performance.	Fewer disposables Reusable warming replaces single-use heating devices, reducing waste and repeat procurement cost.
Faster preparation Compared with common water-circulation and forced-air warming equipment, preparation time is far shorter.	No hose management No pipe or hose connections means less hospital storage space and less preparation effort for staff.

- Thorough cleaning between patients prevents cross-infection.
- Shorter preparation cycle frees clinical staff time before a procedure.
- Reduced storage footprint compared with water-heated and inflatable warming systems.

NEXT STEP

Build It With FlexTherm

FlexTherm develops and manufactures carbon nanotube flexible heating systems for brands, OEM and ODM programmes worldwide. Every solution in this document can be tailored to your geometry, voltage, temperature profile, control logic and certification requirements.

Custom development Heating film layout, flexible electrodes, NTC control board and firmware developed to your specification.	Compliance support RoHS, CE and electrical safety documentation prepared for your target market.
Sampling & scale-up Prototype samples first, then validated tooling and mass production.	Talk to us Shanghai Burning New Material Co., Ltd. — FlexTherm carbon nanotube heating systems.