

# Heater Inks



Creating Material Change



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## Efficient Heating

Graphene is an excellent thermal conductor making it a great material for the fabrication of printable graphene inks for use in a range of applications such as heating elements, flexible and bendable electronics, and wearable technology.

The challenge has been unlocking the full potential of the inert nanomaterial to allow its enhanced properties through a scalable and green process. The inks can be printed using conventional techniques such as screen printing and flexographic printing and embedded in wearable and other devices.

Haydale's heater inks use plasma functionalisation to unlock the effects of materials such as graphene and enhance the thermal conductivity and printability. Haydale's patented HDPlas process also significantly reduces the environmental impact of producing heating elements through less energy being needed when compared to traditional methods.

### Creation

Haydale is creating the next generation of advanced materials for innovative heating solutions.

Our heater inks are manufactured using Haydale's patented HDPlas functionalisation process. Our unique functional inks offer enhanced features:

- Improved consistency
- Improved conductivity
- Better product stability
- Better efficiency
- Self-regulating
- Cost effective
- Operates at low voltage



The enhanced features can be used in a range of applications (see page 3).

### Benefits

- Enhanced thermal conductivity and electrically conductive
- Improved efficiency offering faster heat up times
- Functionalised HDPlas fewer layer graphene (FLGs) with a significantly low surface resistance  $<12 \Omega/\text{sq}$  normalised to  $50 \mu\text{m}$
- Graphene, organic solvent-based ink (no metal)

- Customisable for applications including heating elements, flexible and bendable electronics, and wearable technology
- Tuneable viscosity for improved printability in volume production
- Increased flexibility with the ability to withstand 180 degrees without cracking
- High speed printing abilities such as flexographic
- Low C/V ratios during extensive production quantity in-line tests

### Compared to wired systems:

- Improved heat up and cool down rates
- Self-regulating and uniform heat distribution
- Flexible and easy to install

**23% reduction in k/Wh usage compared to conventional elements**

## Applications

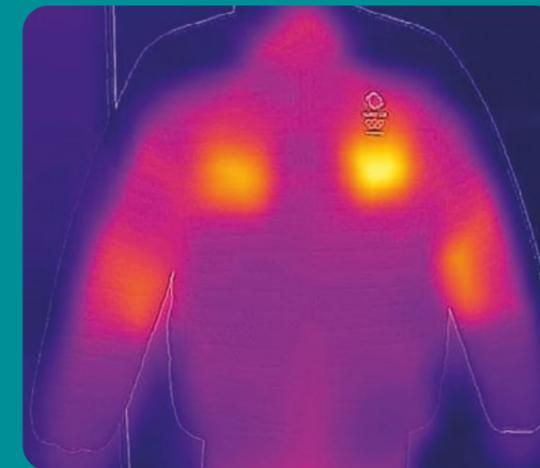
### Heated Garments

Traditionally heated garments use metallic wired elements to heat. Haydale's graphene-enhanced inks reduce the use of metallics and offer a conductive, flexible heating solution for a range of clothing and wearable technology such as muscle group-targeted jackets and trousers and heating pads to help treat joint injuries, pains, arthritis and more.



Haydale's functionalised heater inks have been used in garments worn by medal winning athletes in Tokyo to offer:

- Functional temperatures with a user-controlled range
- Uniform heat distribution
- High heat efficiency at low power
- Rapid thermal response
- Lightweight, compact, flexible, anti-static and washable garments
- Longer battery life

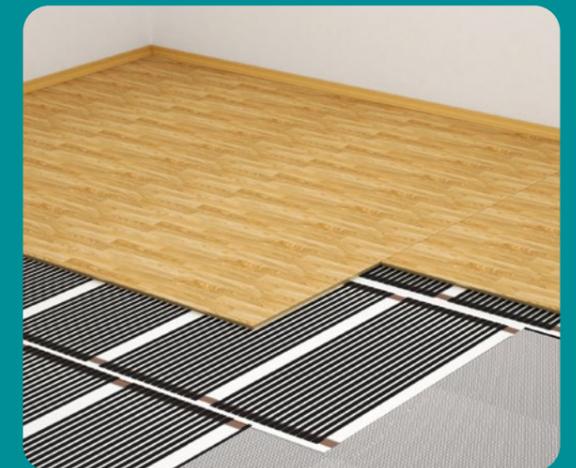


Heated Wearables

### Underfloor / Mobile Heating

With energy challenges and the global need to look at alternative sources of heating, Haydale's low-power flexible heating ink is finding use in advanced technology areas.

Haydale is working extensively in this area to provide alternative heat sources such as flexible underfloor heating in automotive applications. There is also potential applications in marine and domestic settings, with typically 23% more energy than traditional metallic wires.



Underfloor Heating

### Heating Technology

Using the enhanced thermal properties unlocked by Haydale's functionalisation process, other nanomaterials can be used to offer an energy saving solution to domestic and commercial heating.

In a thermal conductive fluid, functionalised nanomaterials have shown increased performance and energy savings of up to 30%.



## Creating Material Change

Haydale has a range of customisable inks for a wide range of applications in the heating market. Contact us for bespoke solutions to meet your specific requirements. Haydale is here to help with end-to-end support from sourcing the correct material for your specific application to creating a commercialised product.



### About Haydale

For heating applications, Haydale offers reliable, proven solutions using functionalised inks. From heated garments to low-powered heating technology, Haydale has developed a suite of inks for a range of heated elements.

Printing using thermally conductive inks has wide reaching commercial opportunities in wearables, electronics, and heating technology. Haydale offers an extensive range of cost-effective nano-enhanced ink products. Our heater inks offer ease of manufacture, quality, product stability, and consistency compared to the widely used graphite and other carbon materials available.

Produced in the UK, our heater inks are manufactured using an environmentally friendly, sustainable plasma process that functionalises an array of graphene-enhanced nanomaterials. Using Haydale's functionalisation process allows for large performance gains in the conductivity of carbon inks.

Haydale is ISO 9001:2015 and ISO 14001:2015 certified. Our functionalised materials are produced to stringent quality control procedures, managed by an experienced team offering a dedicated end to end support service from consultancy through to materials development and application.

### Working with Haydale

This is just a selection of our ink products and applications. Contact our print team today for more information on formulations available for your specific application or product. **Our experts are here to help.**



### Contact us

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