



GRAPHENE  
SQUARE

# The Graphene Radiator

**INVISIBLE BECOMES LUXURY**





## Thermo-Graphene™ Modules for Smart Heaters

The Graphene Radiator is a virtual fireplace that generates heat from graphene, the thinnest (one-atom-thick) and strongest material in the world. Recently discovered, its discoverers were awarded the Nobel Prize in Physics (2010). And now, we bring it to use, where heat can be generated more efficiently with less space and 10~30% less energy. Graphene Heater Modules can be further used as defrost/defogging windows for EV, cameras, and LiDAR sensors.



# ENGINEERING

Graphene, a single sheet of graphite, is the thinnest, the strongest, and the best conductor of heat and electricity, recently discovered and awarded Nobel prize in 2010. When a voltage is applied across the graphene sheets, the honeycomb-structured carbon atoms collide with electron flows and emit strong mid-infrared (mid-IR) radiation, which is more efficient in heat generation compared to conventional coil heaters. Thus, when utilized as a transparent heat radiator, it is advantageous in terms of power-saving, space-saving, and design aspect.

In conventional coil-heaters, the heating power is proportional to electrical resistance, which is opposite in graphene as new physics applies to the atomically thin planar structure. The lower the resistance and the higher the current, the stronger the output of the graphene heater, which is more advantageous in delivering the heats to water-rich objects, because the long wavelength radiation from graphene overlaps more with the infrared (IR) absorption range of water molecules.

# DESIGN

**Foldable Design for Portability:** The flexibility and transparency of graphene enable the thinner and lighter design of a heating device that can project 3D hologram images through the reflected LCD screen, mimicking a real fireplace. The Z-shaped 3 pieces of The Graphene Radiator are completed foldable and angle-adjustable, so it can be carried like a laptop and simply unfolded to use.

**User Experience by Hologram Display:** Real charcoal pieces can be placed behind the front window (on the bottom plate), while the virtual flame on the charcoal is simulated by the hologram display, mimicking a fireplace. A simple food can be placed on the bottom plate and cooked, with displaying recipes, time laps, temperature, etc.

**Heating Function and Safety:** The front window can be mildly heated up to 75° C (167° F) for mild heating (~200W), while to bottom plate can be heated up to 400° C (752° F) for strong heating (~1kW). The bottom heating plate is composed of two glasses gapped by vacuum (with graphene on the upper glass) to minimize the heat flow to the floor.

# INNOVATION

1. For the last century, there has been no major advance in heater technologies since Edison invented coil-based heaters 100 years ago. The graphene heater technology is expected to replace the most of coil-heater applications and designs in home appliances, because it is more reliable, robust, energy-efficient, space-saving, transparent and flexible.

2. The graphene is synthesized from methane (CH<sub>4</sub>), the most global-warming gas, and the side product is hydrogen gas (H<sub>2</sub>) that can be utilized as green fuel. In addition, the graphene heating is more than 30% power-saving. In addition, the graphene in 2-dimension (2D) don't generalate any electromagnetic waves that are potentially harmful to users, enabling more body-friendly and eco-friendly applications.

3. Graphene Square has more than 40 related patents (registered worldwide) on mass-producing graphene films in continuous roll-to-roll (R2R) processes to be applied to heating devices, EMI shielding, etc. Bloomberg highlighted the Graphene Square's patents in the article "Samsung-Apple Smartphone Battleground is Single Atom Thick" (<http://www.bloomberg.com/news/articles/2014-05-15/samsung-apple-smartphone-battleground-is-single-atom-thick-tech>) in 2014.

Model number: GS2023R001, Length 11.8 in, Width 16.8 in, Height 3~15 in (folded and unfolded), Weight 7 pounds, 110~220V, 200W~1kW. The product can also be combined with an additional bottom display module. For more information, visit <http://graphenesq.com/ces2023>



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## Headquarters

### **Graphene Square Inc. (Pohang)**

#407, Business Innovation Center for  
Advanced Technology, 77, Cheongam-ro,  
Nam-gu, Pohang-si,, Republic of Korea  
TEL +82-31-548-2042  
FAX +82-70-5080-0292  
info@graphenesq.com  
www.graphenesq.com

## R&D Center

### **Graphene Square Inc. (Suwon)**

B-dong 1F, Advanced Institute of  
Convergence Technology, 145, Gwanggyo-ro,  
Yeongtong-gu, Suwon-si, Republic of Korea  
TEL +82-31-548-2042  
FAX +82-70-5080-0292  
info@graphenesq.com  
www.graphenesq.com

## US Branch

### **Graphene Square Electronics**

B555 West 5th Street, Los Angeles, California  
90013, United States of America  
TEL 213 220 3279  
FAX +82-70-5080-0292  
electronics@graphenesq.com  
www.graphenesq.com/gse

