The Pioneer of

CVD Graphene Commercialization

www.graphenesquare.com

CES INNOVATION AWARDS 2024 HONOREE

CES INNOVATION AWARDS 2023 BEST OF INNOVATION

ABOUT US

Graphene Square, Inc. is a pioneer in the commercialization of graphene material and graphene films for use as a transparent conductor/heater and in other advanced electronics applications. Established in 2012 as a spin-off of the research of Prof. Byung Hee Hong at Seoul National University and with headquarters in Pohang and R&D Centers in Suwon, Korea.

Our mission is to be the world's first company commercializing CVD graphene technology and No.1 cost-competitive & best-quality graphene film supplier in emerging markets.

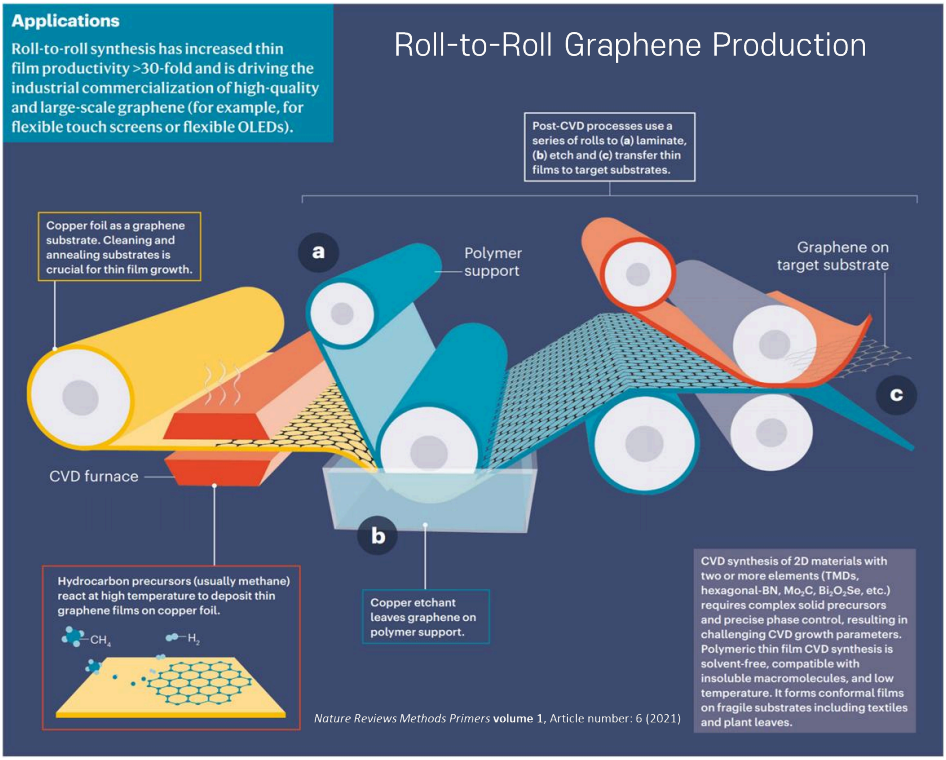
Main Business Areas

Providing CVD Graphene Films & Modules and Fab Service

Graphene Square offers the highest quality graphene samples currently on the market. In addition to the standard samples available online, Graphene Square also provides fab services and 2D materials tailored to the customer's demand.

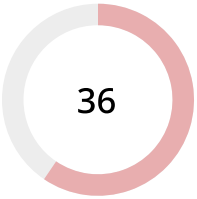
Manufacturing CVD Systems for R&D and Mass-Production

Graphene Square markets advanced CVD systems that allow the users to prepare their own large-area, high-quality graphene and 2D materials samples in a lab environment, which have been installed in renowned institutions including Harvard, MIT, Oxford, Cambridge, Manchester, IBM/ETH, Tehchnion, etc.



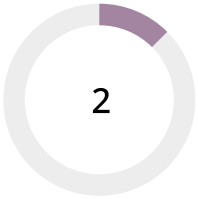
IP Portfolio

Graphene Square's IPs (March 04, 2025) - Domestic

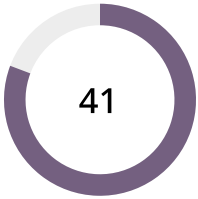


Registered Patent

Registered Design
(GSI Logo)

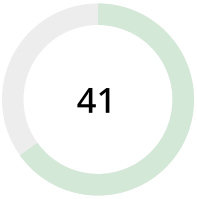


Registered Trademark



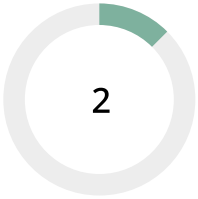
Registered
Industrial Property Rights

Graphene Square's IPs (March 04, 2025) - International

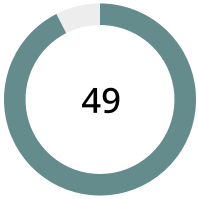


Registered Patent

Registered Design
(GSI Logo)



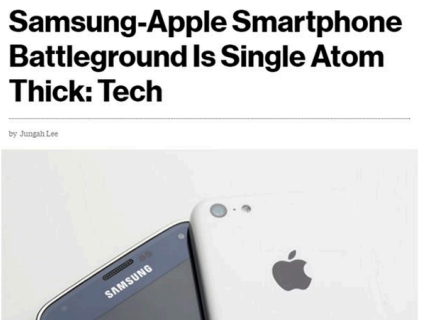
Registered Trademark



Registered
Industrial Property Rights

GSI's Key Patents Highlighted by Bloomberg & Businessweek

Hong says his Graphene Square, Inc. has a patent that can make sheets of the material as large as 50 inches diagonally, about five times the length of an Apple iPad.
The conductive film now most commonly used for mobile-device touch screens, indium tin oxide or ITO, is too brittle for bendable displays and isn't durable or effective enough on devices larger than 10 inches, said Lee Sung Chul, an analyst at Shinyoung Securities Co. in Seoul.
Hong's patents are "key in making cost-efficient, large-scale graphene for touchscreen panels in mass volume."
said Whang Dong Mok, a professor at the School of Advanced Materials Science & Engineering at Sungkyunkwan University in Suwon, South Korea, who predicts wearable devices using the material may arrive on the market within five years.



TCVD-100A

4-inch Semi-Automatic System with Safety Cabinet

TCVD-100A is very sophisticated and cost effective equipment with automatic control system installed. It is the most ideal equipment for high quality graphene research. Safety house that covers whole system protects users from any hazardous event, and the Emergency Stop button will ensure the safety even further.

Features

- Size (mm): 1750 (W) x 1585 (H) x 750 (D)
- Advanced Semi-Auto System.
- Optimized for graphene, CNT, h-BN and TMDC growth.
- Water-cooled end chambers and doors.
- Process Temperature: ~1,000℃

Options

Furnace

- Single – 2 Heating Zone (Standard)
- Dual – 3 Heating Zone
- Single + RF Module

Pumping Unit

- Oil Rotary Pump (Standard)
- Dry Scroll Pump
- Additional: Turbo Molecular Pump

Chamber Size

- 2 inch
- 4 inch (Standard)
- 6 inch
- 8 inch

Warranty

- 1 year – Provided (Standard)
- 2 years – Optional

Gas Control Unit

- 3 MFCs +1 Spare (Standard)
- Up to 8 MFCs

* Price is determined after consulation. (Different customization from the standard parts will affect the overall price)

TCVD-100A

4-inch Semi-Automatic System with Safety Cabinet

Customers / Demo Sites

Harvard University

University of Cambridge

University of Oxford

University of North Taxas

Columbia University

Hochschule
für Technik FHNW

King Abdullah University

Israel Institute of Technology

Gwangju Institute
of Science and Technology

Tech University of Korea

IMIP CNR

Ntnu Nanolab

Micro Photonics

TCVD-RF100CA

Premium Custom Design System for TMDCs & h-BN

Chemical vapor deposition (CVD) system for the syntheses of 2D materials at scales from a chip to a wafer, including the synthesis of graphene, h-BN, TMDCs on various substrates by use of gas-phase or solid precursors and metal-organic (MO) sources.

Features

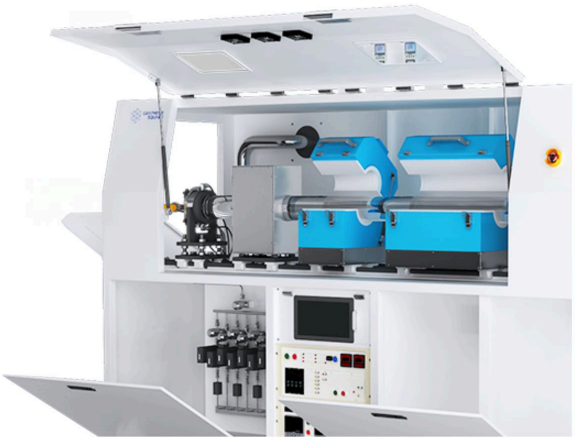
- Size (mm): 2300 (W) x 1770 (H) x 750 (D)
- Up to 10 gases and 3 MO sources for gas-phase synthesis.
- Motor-controlled movable heater for fast heating and cooling (patented).
- Fully computer-controlled programmable recipes.
- TCVD100 platform: Proven performance for ~100 systems for more than 5 years.
- Invited training for full sample preparation processes.

Customers / Demo Sites

Seoul National University
Graphene Research Center

IBM Zürich Nanotech Center

Israel Institute of Technology



TCVD-DC100CA

Premium Custom Design Dual CVD System with a Glove Box

Chemical vapor deposition (CVD) system for the syntheses of 2D materials at scales from a chip to a wafer, including the synthesis of graphene, h-BN, TMDCs on various substrates by use of gas-phase or solid precursors and metal-organic (MO) sources. The glove box enables the synthesis of various air-sensitive TMDCs.

Features

- Size (mm): 3000 (W) x 1800 (H) x 750 (D)
- Up to 10 gases and 3 MO sources for gas-phase synthesis.
- Motor-controlled movable heater for fast heating and cooling (patented).
- Fully computer-controlled programmable recipes.
- TCVD100 platform: Proven performance for ~150 systems for more than 10 years.
- Invited training for full sample preparation processes from synthesis, etching, and transfer.
- Supply of high-quality source materials.
- 1 year warranty included (2 year extended).
- CVD chambers connected to a Glove Box. Free from air exposure.

Customers / Demo Sites

Seoul National University
Graphene Research Center

Israel Institute of Technology

Duke University

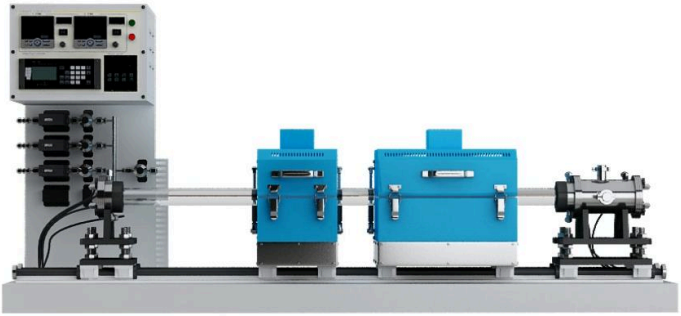
Technical Specification

Reactor	• Tube type 4 inch diameter quartz. • Connected to a glove box.
Substrate Size	• Lateral insertion of 10 mm to < 4 inch wafers possible (Loading frames for small samples). • Rolled metallic foils can be loaded to synthesize A4 sized or larger 2D materials.
Furnace	• Dual-zone heater and controller for graphene/h-BN synthesis. Single-zone precursor heater and Dual-zone deposition heater for TMDC synthesis. • The heaters are movable along two rails and the distance can be motor-controlled. • Remote RF Plasma Module.
Base Pressure	• 10^{-5} mbar (depending on the dryness of source).
Operating Pressure	• 10^{-3} mbar ~ 1 bar
Precursor	• Max 10 gas lines (ex. CH_4, B_2H_6, Ar, H_2, O_2, etc.) • Metal oxide sources of various transition metals placed in Heat Zone 1 for solid source growth.
Other metal organic (MO) sources	• Extra 3 metal-organic source injection ports are included. (ex $Mo(CO)_6$, $Fe(CO)_5$)
Flow control	• Precursor gases: 0.1 ~ 10 sccm • Other gases: 10 ~ 1000 sccm • Automatic flow control.
Vacuum	• Cold trap for residual sources. • Turbo pump 450l/s (ISO160) < 10^{-6} mbar. • Dry scroll pump < 10^{-1} mbar. • Main gate valve pneumatic type / fore-line / roughing angle valve / foamed bellows. • By-pass pumping adaptor, clamp & centering.
System Control	• Control PC system. • Serial network module. • Remote IO Module. • System base programming / System recipe control module / System date file save module. • Software upgrade support.

TCVD-50B

2-inch Table-Top Manual Type Thermal CVD

This small size equipment was developed on customers' demand on low-cost but high quality synthesizer. Every research had its potential, but not all researches are funded well. TCVD-50B is the most ideal system for institutes who are limited in budget or those who searches for cost-effective equipment.



Features

- Size (mm): 1500 (W) x 893 (H) x 590 (D)
- Economic & space-saving model.
- Optimized for graphene, CNT, h-BN and TMDC growth.
- Water-cooled end chambers and doors.
- Process Temperature: ~1,000℃
- Protective design from heat.
- Uniformity of Film Thickness: ≤+-3%
- Testing Uniformity: ≤+-3%
- Movable furnace method is our unique knowhow for fast heating and fast cooling of the sample.

Options

Furnace

- Single – 2 Heating Zone (Standard)
- Dual – 3 Heating Zone
- Single + RF Module

Pumping Unit

- Oil Rotary Pump (Standard)
- Dry Scroll Pump
- Additional: Turbo Molecular Pump

Chamber Size

- 2 inch (Standard)
- 4 inch

Gas Control Unit

- 3 MFCs +1 Spare (Standard)
- Up to 5 MFCs

Warranty

- 1 year – Provided (Standard)
- 2 years – Optional

Customers / Demo Sites

Massachusetts Institute of Technology

Boston University

Universidade Mackenzie

Washington University

University of California Los Angeles

Korea University of Technology and Education

Kwangwoon University

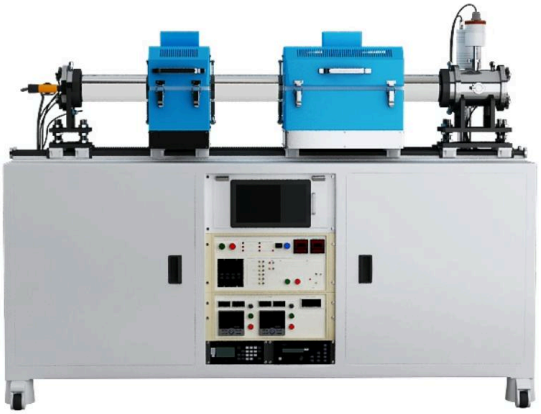
Chullalongkorn University

Agency for Defense Development

TCVD-D100CA

4-inch Computer-Controlled Dual-Furnace CVD System

TCVD-D100CA is a typical equipment for TMDC growth. Computer installed controller promises the advanced condition control to the users. It is the most ideal equipment for high quality TMDC research. Dual furnace system enables control temperatures on source material and substrate. Safety housing and Emergency Stop button will ensure the safety of users.



Features

- Size (mm): 2300 (W) x 1770 (H) x 750 (D)
- Advanced Computer Controlled Automatic System.
- Optimized for graphene, CNT, h-BN and TMDC growth.
- Water-cooled end chambers and doors.
- Process Temperature: ~1,000℃
- Uniformity of Film Thickness: ≤+-3%
- Testing Uniformity: ≤+-3%
- Movable furnace method is our unique knowhow for fast heating and fast cooling of the sample.
- Standard safety box.

Options

Furnace

- Single – 2 Heating Zone
- Dual – 3 Heating Zone (Standard)
- Threefold – 4 Heating Zone
- Single or Dual + RF Module

Chamber Size

- 2 inch
- 4 inch (Standard)
- 6 inch
- 8 inch

Gas Control Unit

- 3 MFCs +1 Spare (Standard)
- Up to 10 MFCs

Pumping Unit

- Oil Rotary Pump (Standard)
- Dry Scroll Pump
- Additional: Turbo Molecular Pump

Warranty

- 1 year – Provided (Standard)
- 2 years – Optional

Customers / Demo Sites

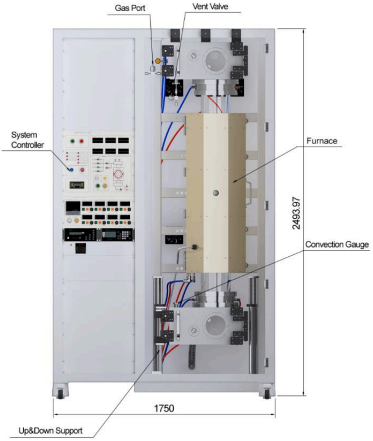
Seoul National University
Graphene Research Center

* Price is determined after consulation. (Different customization from the standard parts will affect the overall price)

TCVD-V200A

8-inch Rapid Thermal Vertical Roll-to-Roll System

Graphene Square was the first group to publish paper on Roll-to-Roll(R2R) method for mass production of graphene. TCVD-V200A is vertical tube type equipment that enables the large scale deposition of graphene film.



Features

- Size (mm): 1500 (W) x 2500 (H) x 1000 (D)
- Advanced Semi-Auto Vertical Tube Roll-to-Roll System.
- Optimized for large graphene synthesis.
- Rapid heating furnace reaches 1,000℃ in 10 min.
- Water-cooled end chambers and doors.
- Process Temperature: ~1,000℃
- Uniformity of Film Thickness: ≤+-3%
- Testing Uniformity: ≤+-3%
- Rapid heating and automatic rolling system is ideally the first stage of graphene mass production.
- Standard safety box.

Customization

Furnace

- Single – Kanthal A1 Heater (Standard)
- Single – Halogen Heater

Chamber Size

- 8 inch

Gas Control Unit

- 3 MFCs +1 Spare (Standard)
- Up to 5 MFCs

Pumping Unit

- Oil Rotary Pump (Standard)
- Dry Scroll Pump
- Additional: Turbo Molecular Pump

Warranty

- 1 year – Provided (Standard)
- 2 years – Optional

Customers / Demo Sites

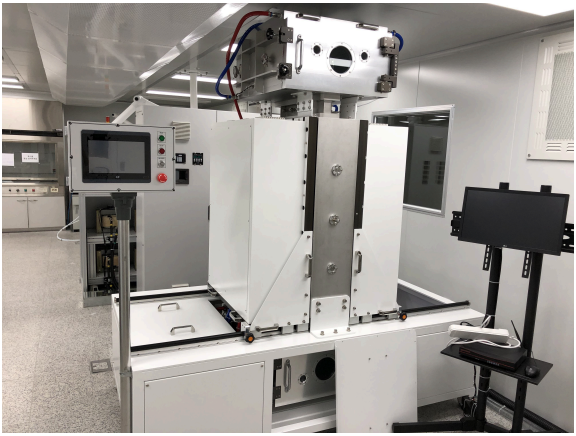
Advanced Institute of Convergence Technology

* Price is determined after consulation. (Different customization from the standard parts will affect the overall price)

TCVD-V600A

600mm-Wide Vertical Roll-to-Roll System

This equipment is designed to grow high-quality graphene on a 450mm-wide Cu foil and to stably and continuously supply graphene for research on the development of various next-generation logic devices and sensors.



Features

- Size (mm): 3800 (W) x 2550 (H) x 3500 (D)
- Economic & space-saving model.
- Optimized for Roll to Roll graphene growth.
- Process Temperature: ~1,000.C
- Protective design from heat.
- Unifomity of Film Thickness: +- 3%
- Testing Uniformity: ≤+-3%

Customization

Furnace (Graphite Heater)

- 3 Zone (Only Option)
- 5 Zone

Sample size

- 150mm~450mm

Gas Control Unit

- 3 MFCs +1 Spare (Standard)
- Up to 5 MFCs

Pumping Unit

- Oil Rotary Pump (Standard)
- Dry Scroll Pump
- Additional: Turbo Molecular Pump

Warranty

- 1 year – Provided (Standard)
- 2 years – Optional

Customers / Demo Sites

Advanced Institute of Convergence Technology

Pohang University of Science &Technology

* Price is determined after consulation. (Different customization from the standard parts will affect the overall price)

CVD Graphene on Cu foil

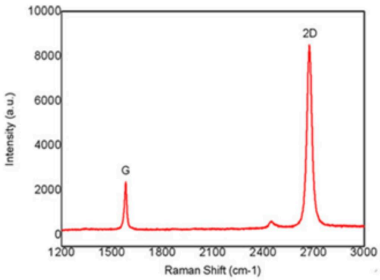
Applications

- Support for metallic catalyst
- MEMS or NEMS
- Conductive coating
- Anti-oxidation coating
- Transparent heater

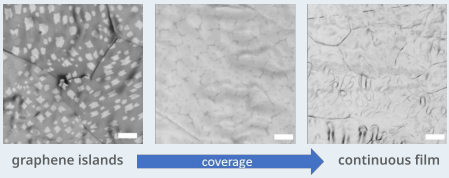
Details

Product Size	Up to 500x600㎟
Film morphology	Continuous Monolayer (>95%)
Sheet Resistance	-
Mobility	>3500cm²/Vs
Transmittance	>97%
Substrate	Cu foil (35㎛ thick)
Domain Size	3-12㎛

Raman Spectrum



SEM images of graphene on Cu



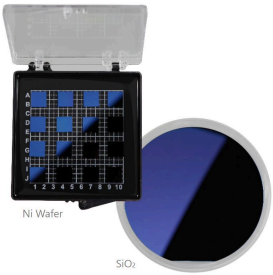
References

- (1) S. Bae*, H. Kim* et al. "Roll-to-roll production of 30 inch graphene films for transparent electrodes" Nature Nanotech. 5, 574 (2010).

CVD Graphene on SiO_2 Wafer/PET/Glass

Applications

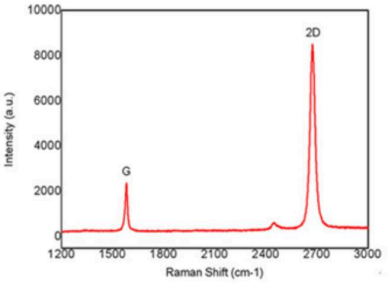
- Flexible/stretchable electronics
- Transparent electrodes
- Flexible heaters
- FETs
- Gas sensors
- Bio sensors
- Strain sensors



Details

Product Size	Up to 500x600㎟
Film morphology	Continuous Monolayer (>95%)
Sheet Resistance	Av. < 250~400 Ω/sq
Mobility	>3500 cm^2/Vs
Transmittance	>97%
Substrate	PET (188㎛) quartz, glass, sapphire
Domain Size	3-12㎛

Raman Spectrum



Customized Samples

- max size ~ 400 mm x 400 mm
- No. layers 1~4 (layer-by-layer transfer by thermal release tape or PSAF

References

- (1) S. Bae*, H. Kim* et al. "Roll-to-roll production of 30 inch graphene films for transparent electrodes" Nature Nanotech. 5, 574 (2010)
- (2) K S. Kim et al. "Large-Scale Pattern Growth of Graphene Films for Stretchable Transparent Electrodes." Nature457, 706 (2009) [pdf].

Graphene Square's Global Customers

High-quality Samples for Research & Development

Graphene Square supports the R&Ds of global academic and business institutes and companies by providing customized samples with high reliability and quality. In addition, Graphene Square are supplying large amount of graphene films for various Proof-of-Concept projects with Samsung, LG, GM, Hyundai, etc.

Mass-production Factory in Pohang, Korea to be completed by October, 2025.

GRAPHENE SQUARE

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