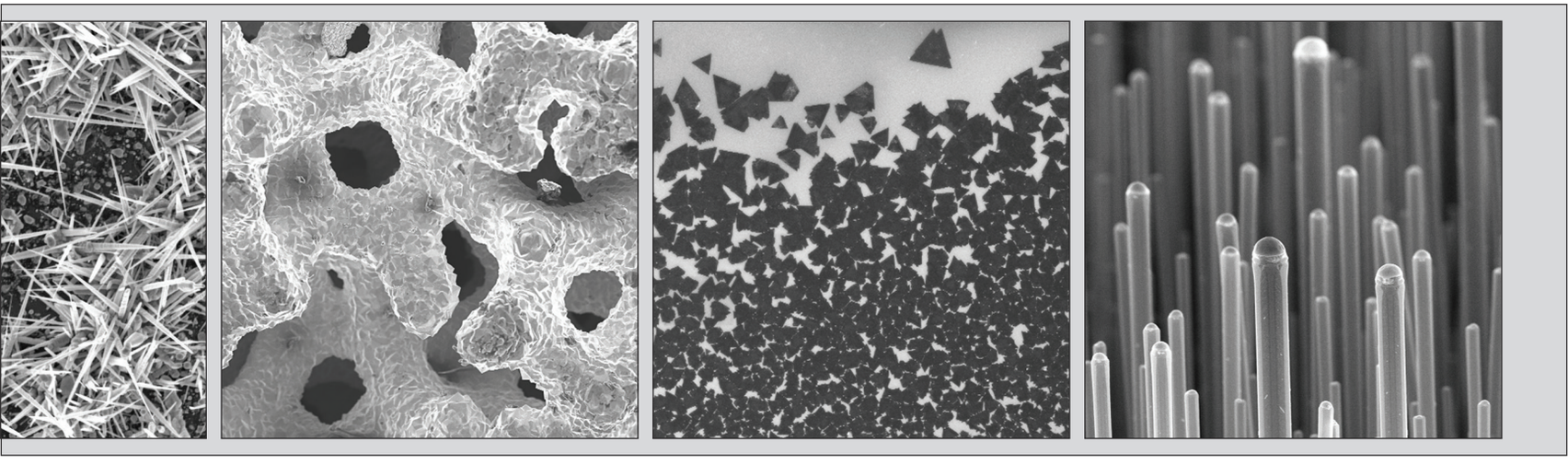
enabling tomorrow's technologies™

CVD Equipment Corporation

firstnano



FirstNano® EasyTube® Systems

powered by CVDWinPrC™

SEMI- S2/S8 and CE compliant

www.cvdequipment.com | www.firstnano.com

FirstNano® EasyTube® Systems Overview

Configurable CVD systems for advanced research & development

CVD Equipment Corporation provides a range of FirstNano® advanced research and development chemical vapor deposition process tools for universities, startups, and industry research laboratories.

The systems are designed to meet today's safety standards for handling pyrophoric, corrosive, flammable, and toxic gases such as hydrogen, silane, germane, diborane, hydrogen chloride, and metal organic precursors. All our systems are designed with exhausted metal cabinet enclosures which contain the reactor, furnace, power control, gas distribution, and electrical systems. The systems are engineered with ease of access to all components for maintenance purposes.

FirstNano® systems are powered by CVD*WinPrC*™, our proprietary realtime instrument control, data logging, and process editing software suite. CVD*WinPrC*™, included as standard, is equivalent to the package included with our industry-ready production equipment. A web interface connection allows for remote training, software upgrades, and system troubleshooting.

Our SDC® ultra-high purity gas lines and delivery systems are manufactured at our Stainless Design Concepts location in upstate New York. We take advantage of a 4,000 ft^2 clean room fabrication facility, with multiple high purity orbital welding stations.

Our manufacturing is vertically integrated; we procure raw materials and deliver finished systems. Contact us to schedule a visit to our facility on Long Island, New York, where you can witness our quartz fabrication, machining, and build/test facilities.

FirstNano® systems can be configured with a range of modules to meet the often unique requirements of the R&D environment. More information can be found by visiting our website at www.firstnano.com.

"The turnkey EasyTube® System is the most practical and convenient instrument for solutions in nanostructure synthesis."

FIU

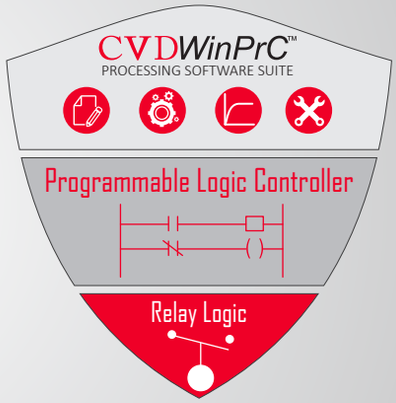
DR. WONBONG CHOI
Professor of Mechanical & Materials Engineering
Florida International University

powered by CVD*WinPrC*™

Operated through our CVD*WinPrC*™ process control software, the system automatically logs data and graphically shows time-dependent values of user-selected parameters. CVD*WinPrC*™ also allows users to load preprogrammed recipes, modify, check and create new recipes, and view realtime or saved process data.

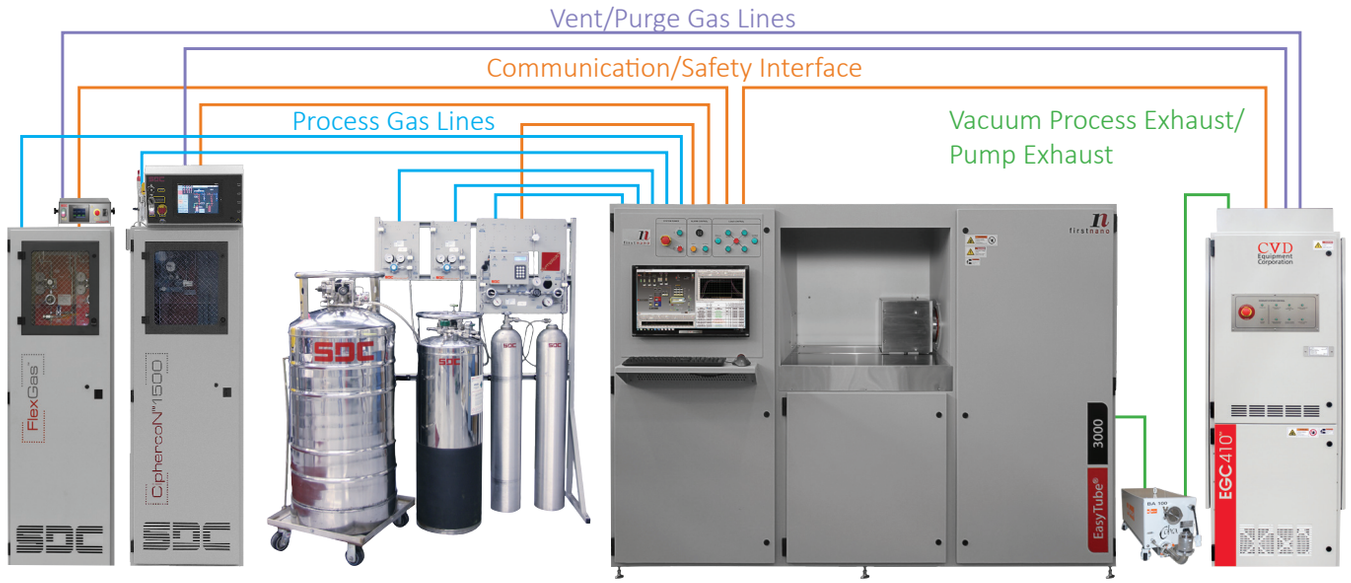
Safety Protocols

The system has application configured safety protocols embedded into relay logic, PLC, and CVD*WinPrC*™ software.



Support Equipment Overview

Pair with top of the line gas & chemical delivery and exhaust abatement systems



Gas Delivery Cabinets

The FlexGas® and CiphercoN™ 1500 gas cabinets are designed to cover a wide range of gas delivery applications. In its simplest form, the CiphercoN™ gas cabinet houses 1, 2, 3, or 4 gases, and includes a high purity, manual gas panel for each gas.

UHP Panels

Our MicroLine™ UHP manual gas panels are designed for high and low pressure, ultra-high purity (UHP) gas delivery. Typically used for non-hazardous purge and process gas delivery applications, the MicroLine™ Series offers 1, 2, 3, 4, and 6-valve designs.

Abatement

Our Exhaust Gas Conditioning (EGC) systems will thermally decompose explosive, flammable, and pyrophoric exhaust gases. The wet scrubber removes particles from the exhaust stream. The systems include optional neutralization of corrosive effluent.

CVD Equipment Corporation offers our FirstNano® R&D CVD processing systems with support equipment such as gas cabinets and exhaust gas conditioning systems. All major components from one vendor make component interfacing seamless.

Call us at **+1 631-981-7081** to discuss a product solution for your project.
We can also be reached at **sales@firstnano.com** or visit our website.

EasyTube® 101 Features

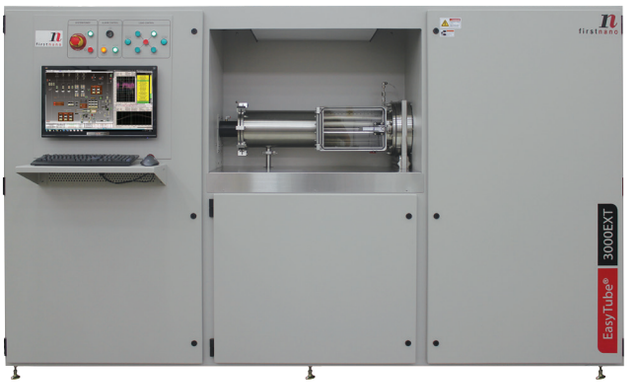
- CVD*WinPrC*™ system control software for realtime process control, data logging, and recipe editing
- Preprogrammed process recipes and startup support
- Substrate area 25 mm x 50 mm
- Cantilevered automatic substrate loading/unloading system
- Up to 8 MFC-controlled gas lines and 3 liquid/solid sources
- Atmospheric and/or low pressure process configurations available
- Dual o-ring process seals with a vacuum monitoring system to ensure leak free operation
- 3-zone resistance furnace for temperatures up to 1100 °C
- Proprietary realtime cascade temperature control
- User ability to set warnings and alarms
- Comprehensive software and hardware safety interlocks

EasyTube® 2000 Features

- CVD*WinPrC*™ system control software for realtime process control, data logging, and recipe editing
- Preprogrammed process recipes and startup support
- Substrate sizes up to 50 mm x 50 mm
- Cantilevered automatic substrate loading/unloading system
- Up to 8 MFC-controlled gas lines and 3 liquid/solid sources
- Atmospheric and/or low pressure process configurations available
- 3-zone resistance furnace for temperatures up to 1100 °C or optional rapid thermal processing with IR heater
- Proprietary realtime cascade process temperature control
- High throughput with FastCool™ furnace
- User ability to set warnings and alarms
- Comprehensive software and hardware safety interlocks

EasyTube® 3000 Features

- CVD*WinPrC*™ system control software for realtime process control, data logging, and recipe editing
- Preprogrammed process recipes and startup support
- Substrate sizes up to 100 mm x 100 mm (batch processing of multiple wafers per run also possible)
- Cantilevered automatic substrate loading/unloading system
- Up to 12 gas lines and 4 liquid/solid sources
- Atmospheric and/or low pressure process configurations available
- 3-zone resistance furnace for temperatures up to 1200 °C or optional IR / RF heating
- Proprietary realtime cascade process temperature control
- High throughput with FastCool™ furnace
- User ability to set warnings and alarms
- Comprehensive software and hardware safety interlocks



EasyTube® 3000EXT Features

- CVD*WinPrC*™ system control software for realtime process control, data logging, and recipe editing
- Preprogrammed process recipes and startup support
- Substrate sizes up to 150 mm x 150 mm (batch processing of multiple wafers per run also possible)
- Loadlock / glovebox options
- Cantilevered automatic substrate loading/unloading system
- Up to 16 MFC-controlled gas lines and 4 liquid/solid sources
- Atmospheric and/or low pressure process configurations available
- 3-zone resistance furnace for temperatures up to 1200 °C or optional IR / RF heating
- Proprietary realtime cascade process temperature control
- High throughput with FastCool™ furnace
- User ability to set warnings and alarms
- Comprehensive software and hardware safety interlocks

EasyTube® 6000 Series Features

- Mounting choices: left hand, right hand, bulkhead, ballroom
- Up to 4 process tubes
- CVD*WinPrC*™ system control software for realtime process control, data logging, and recipe editing
- Wafer sizes: 3 tube stack = 200 mm | 4 tube stack = 150 mm
- Up to100 wafers per load (process dependent). Larger loads are available upon request
- Cantilevered automatic substrate loading/unloading system
- Up to 6 MFC-controlled gas lines and 1 liquid/solid source per process tube
- Atmospheric and/or low pressure process configurations available
- 3-zone resistance furnace for temperatures up to 1200 °C
- Proprietary realtime cascade process temperature control
- User ability to set warnings and alarms
- Comprehensive software and hardware safety interlocks

Gas Delivery & Exhaust Abatement

MicroLine™ UHP manual gas panels are designed for high and low pressure, ultra-high purity (UHP) gas delivery. Typically used for non-hazardous purge and process gas delivery applications, the SimplicitY™ Series offers 1, 2, 3, 4, and 6-valve designs.

FlexGas™ and CiphercoN™ 1500 gas cabinets house 1, 2, 3, or 4 gases, and include high purity, manual gas panels for each gas.

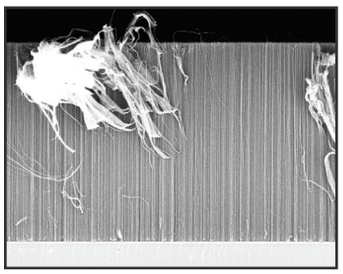
The EGC burn box will thermally decompose explosive, flammable, and pyrophoric exhaust gases. The wet scrubber removes particles from the exhaust stream. The EGC pyrolizer + wet scrubber includes optional neutralization of corrosive effluent.

There are more options available on any of these models. Please consult factory for details.

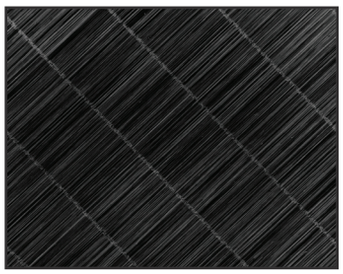
Nanomaterials SEM Gallery

Materials developed using a FirstNano® EasyTube® system

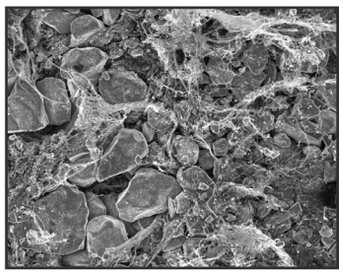
Carbon Nanotubes



VERTICALLY ALIGNED CNTs

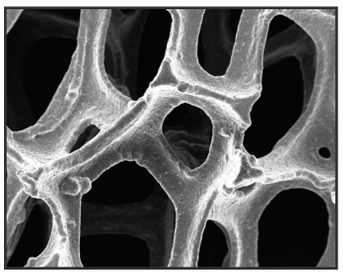


HORIZONTALLY ALIGNED CNTs

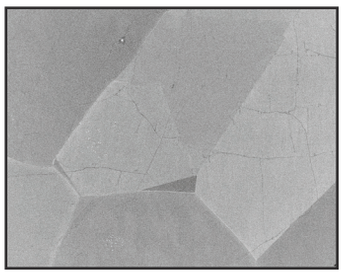


CARBON NANOTUBE PAPER

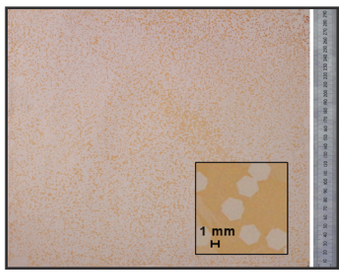
Graphene



3D GRAPHENE FOAM

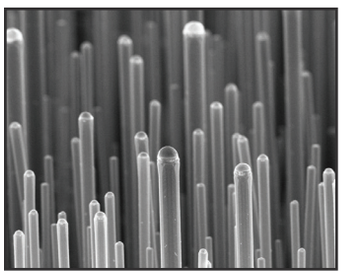


SINGLE LAYER GRAPHENE

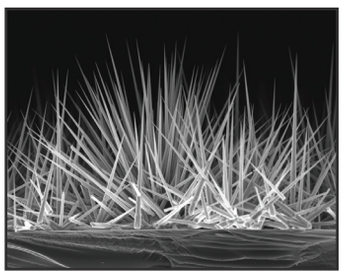


SINGLE CRYSTAL GRAPHENE

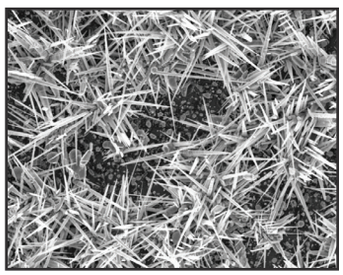
Nanowires



SILICON NANOWIRES

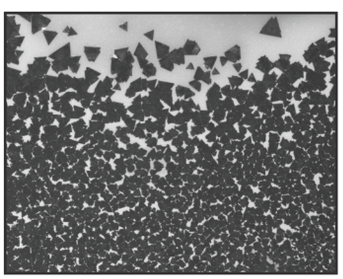


ZINC OXIDE NANOWIRES

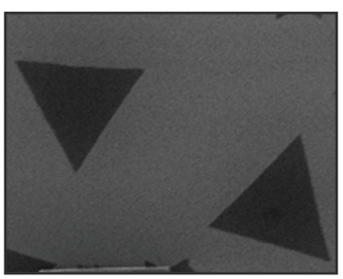


GALLIUM NITRIDE NANOWIRES

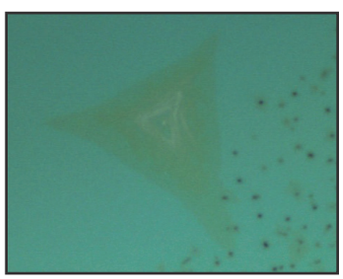
Transitional Metal Dichalcogenides



2D MOLYBDENUM DISULFIDE



TMDs ON SILICON WAFER

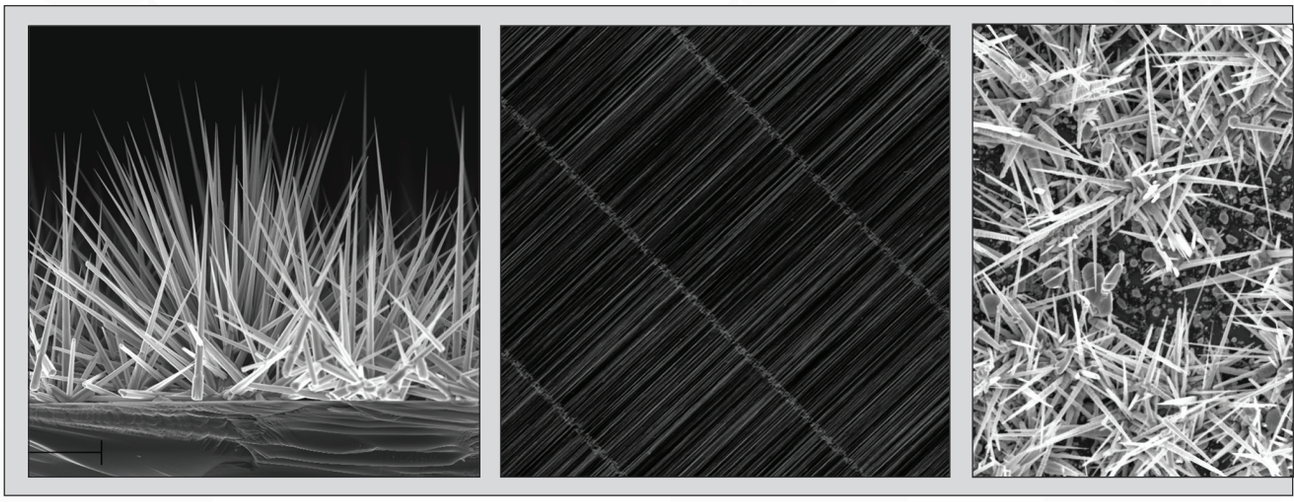


TMDs ON SILICON WAFER

PROCESSES	ET101	ET2000	ET3000	ET3000EXT	ET6000
Carbon Nanotubes	✔	✔	✔	✔	N/A
Graphene	✔	✔	✔	✔	N/A
2D Materials (TMDs, h-BN, etc)	✔	✔	✔	✔	✔
Semiconducting Nanowires (Si, Ge, ZnO, GaN, etc)	✔	✔	✔	✔	✔
Transparent Conductive Oxide (SnO:F, ZnO:B, etc)	✔	✔	✔	✔	N/A
Epitaxial Deposition	✔	✔	✔	✔	N/A
Atmospheric Pressure CVD (APCVD)	✔	✔	✔	✔	✔
Low Pressure CVD (LPCVD)	✔	✔	✔	✔	✔
Metal Organic CVD (MOCVD)	✔	✔	✔	✔	✔
Plasma Enhanced CVD (PECVD, PACVD, ICP-CVD)	N/A	✔	✔	✔	N/A
Rapid Thermal Processing (RTP)	N/A	✔	✔	✔	N/A
Chemical Vapor Infiltration (CVI)	✔	✔	✔	✔	✔
Fluidized Bed CVD (FBCVD, FBR)	N/A	✔	✔	✔	N/A
Atomic Layer Deposition (ALD)	✔	✔	✔	✔	N/A
Dry Oxidation	N/A	N/A	✔	✔	✔
Wet Oxidation	✔	✔	✔	✔	✔
Pyrogenic Oxidation	N/A	N/A	N/A	✔	✔
Diffusion	✔	✔	✔	✔	✔
Silicon Nitride	✔	✔	✔	✔	✔
Polysilicon	✔	✔	✔	✔	✔
Silicon Dioxide	✔	✔	✔	✔	✔
Annealing	✔	✔	✔	✔	✔

All systems include CVD*WinPrC*™ system control software, comprehensive software and hardware safety interlocks, preprogrammed process recipes, and startup support. Other configurations available, consult factory for details.

firstnano®



COVER IMAGES left to right: ① Zinc Oxide Nanowires ② Horizontally Aligned Carbon Nanotubes ③ Gallium Nitride Nanowires ④ Tantalum Foam ⑤Transition Metal Dichalcogenides ⑥ Silicon Nanowires

CVD Equipment Corporation

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