



sp3 Model 650 HOT FILAMENT CVD DIAMOND COATING SYSTEM

For deposition of high-quality diamond films
in production and R&D



Performance ♦♦♦ Quality ♦♦♦ Value



The Model 650 System's integrated process controller provides precise and repeatable diamond deposition in both production and R&D applications.

Excellent diamond thickness uniformity

- $\pm 10\%$ over a 300mm wafer
- Accommodates demanding applications

High throughput

- Broad deposition area 350mm x 375mm
- Large chamber size
- Deposition rate up to 1.1 microns/ hour
- Fast turnaround

Wide range of 2D and 3D applications

- Flexible filament configuration
- Variable internal fixturing

Consistent performance

- Exceptional process repeatability

Precise process control

- Diamond coating morphology easily tuned for desired performance

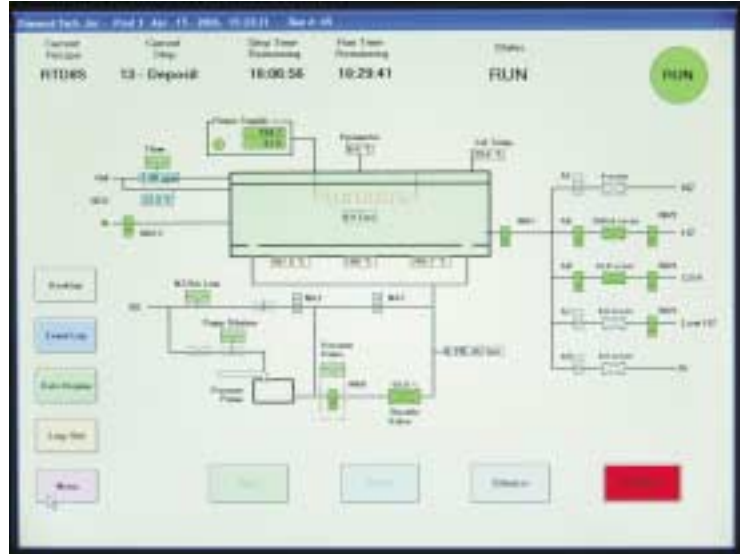
Low cost operation

- Less than 0.4kwh power consumption per cubic mm of diamond deposited
- High uptime >95%
- MTBF greater than 500 hours

Precise control of the deposition process and reactor operation via computer command

The Model 650 is easy to use

A Graphical User Interface (GUI) enables the operator to quickly view the system process status. All process parameters—temperature, pressure and gas flow values—can be seen at a glance. Highlighted parameters together with audible and visual indicators quickly alert the operator to alarm or abort conditions, permitting prompt response. The touch-screen display provides easy access to menus and primary operational control functions. More involved engineering and maintenance functions are accessed via dedicated menus in a Windows format. A Control Screen enables manual control of process variables for authorized personnel.



Fast creation and editing of process recipes

A Recipe Manager facilitates creation of new process recipes and quick, easy editing of existing recipes. Recipes with up to 58 discrete process steps can be created. Parametric control of all process variables is achieved through assignment of applicable setpoints and digital inputs at each process step. Limits can be programmed to initiate alarm and abort commands on key process parameters. Recipes can be stored within production and engineering folders, with multi-level access control via a tiered security system. Remote recipe management is provided by a stand-alone application and remote computer/network connection via an Ethernet port.

Complete process run histories can be maintained

Run process data is recorded at user-programmable intervals to assist with process development, routine maintenance and troubleshooting tasks. This data is logged to yield a permanent record for future reference. All key process parameters, digital I/O states and events for the current recipe are easily viewed through the data display. A separate event log makes it convenient to view a summary of run step changes for an entire process run. In addition, a stand-alone data viewer affords review and export of process data history files.



Real-time control of process variables

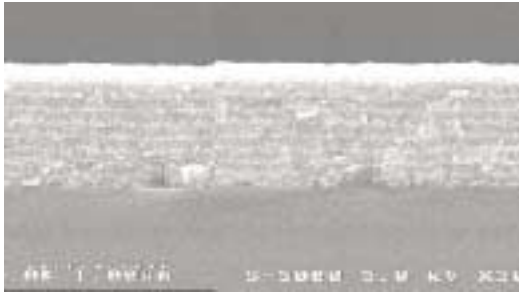
The process control module permits real-time control of all key process variables. In addition to assuring run-to-run repeatability in a production mode, this facilitates process development and optimization of variables to achieve performance objectives.

Programmable alarm and abort levels can be set to prevent deviation outside of set limits and thereby prevent material scrap. Hardware safety features and interlocks protect the equipment and operating personnel.

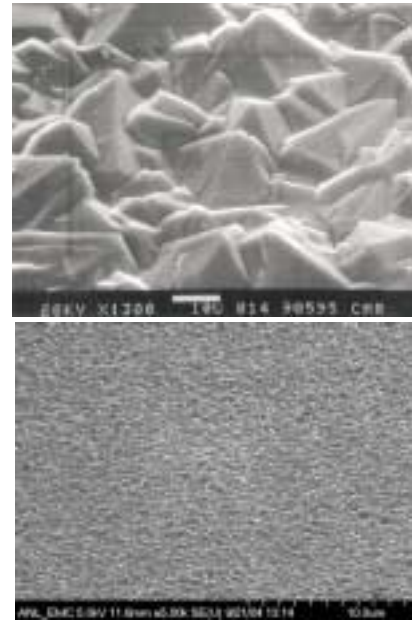
Precise control of the diamond film

Precise process controls can produce ultra-smooth nano-crystalline diamond coatings or rougher micro-crystalline structures. Film thickness can be controlled from 1000 Angstroms to 100 microns. Grain size can be controlled from less than 10 nanometers to a size equal to film thickness.

Other process capabilities include conformal coatings in two or three dimensions, and varying levels of adhesion and nucleation density. Graded layer deposition may also be performed by alternating grain sizes in a multi-layer stack. (Patent nos. 6,063,149, 6,319,610, 6,533,831).



This multilayered fine grain film has an overall thickness of 1 micron and is composed of ten 100 nanometer layers.



SEM photographs depicting the wide range of grain structures obtainable with the Model 650 CVD System.

Applications of diamond coatings

Diamond on silicon

Diamond coatings are finding increasing use in electronic applications because of the high thermal conductivity of diamond (4x that of copper). Coatings up to 25 microns thick on 300mm silicon wafers provide excellent heat spreading on a wafer-scale basis. Silicon-diamond-silicon wafers have been used successfully as base wafers for gallium nitride growth. Nanocrystalline diamond coatings are being routinely used in MEMS applications.



200mm and 100mm diamond coated silicon wafers. The colored fringes indicate a $\pm 5\%$ uniformity of the deposited diamond film on this 100mm wafer.



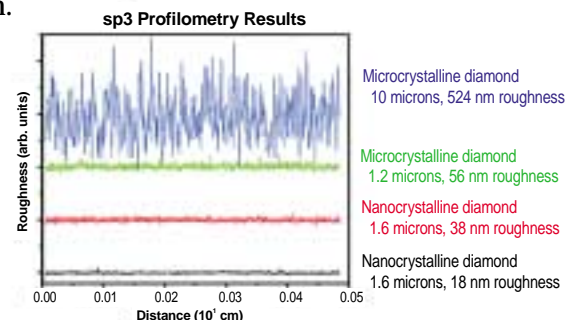
Diamond-coated titanium electrode, 12 in. by 12 in.

Electrode coatings

High biocompatibility and extreme chemical resistance make diamond a good choice for electrode coatings. Diamond coatings are finding application in electrodes for water treatment and electrochemistry. Diamond coatings can be doped in the Model 650 to achieve the desired electrical conductivity for any given application.

Wear surfaces

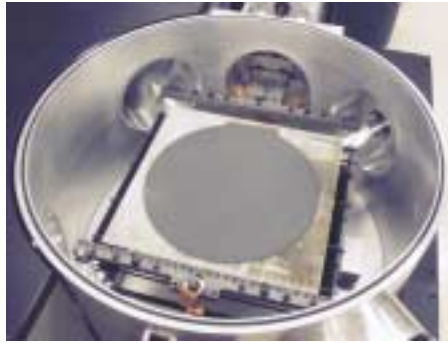
Diamond coatings can be used to protect surfaces that are prone to heavy wear. Smooth, adherent diamond coatings afford protection from wear while in many applications imparting lower friction than other materials. These coatings can significantly extend the life of wear parts and reduce maintenance costs dramatically. Diamond film morphology can be controlled to achieve the required performance.



(Compliments of Advanced Diamond Technologies.)

Ideal for wafer deposition

The spacious chamber and broad deposition area can accommodate nine 100mm wafers, four 150mm wafers, two 200mm wafers or one 300mm wafer.



Cutting tools

The proliferation of highly abrasive composite materials across many industries has created a huge demand for diamond coated cutting tools. Combining large capacity, high throughput and very uniform coatings, sp3 reactors are optimally suited to cutting tool applications. Coatings from 5 to 50 microns can be applied to tungsten carbide inserts, drills, endmills and a wide variety of specialized tools.

The diamond coated tools are ideal for machining graphite, green ceramic, fiber reinforced plastics, carbon fiber composites, metal matrix composites and aluminum die castings with high silicon content.



The deposition chamber's wide access lid and low height make it easy to load and unload tools and other parts.

Options for sp3 Model 650 Diamond Coating System

- **Planar array** package — for flat substrates which require a coating on one planar surface.
- **Silicon wafer** package — for coating wafers; specify 100mm, 150mm, 200mm or 300mm.
- **Substrate cooling** package — for controlling backside wafer temperature.
- **Three-dimensional array** package — for applications and substrates which require coating in more than one plane.
- **Flat cutting tool** package — for use on all tungsten carbide inserts, grooving tools, engravers, etc.
- **Round cutting tool** package — for coating drills, endmills, countersinks, routers and other rotating tungsten carbide tools.



sp3 Diamond Technologies

2220 Martin Avenue
Santa Clara, CA 95050
877/773-9940; 408/492-0630
fax: 408/492-0633
email: diamond@sp3inc.com
web: www.sp3inc.com

*Seki Technotron is the global distributor for sp3 CVD systems.
For more information please contact Seki Technotron.*



Headquarters
5-6-30 Kiba, Koto-ku, Tokyo 135-0042
81-3-3820-1711 fax 81-3-3820-1735

Seki Technotron USA

2220 Martin Avenue
Santa Clara, CA 95050
888/273-6225; 408/986-9190
fax: 408/986-9191
email: bjohnson@sekitech.com
web: www.SekiCVDSolutions.com