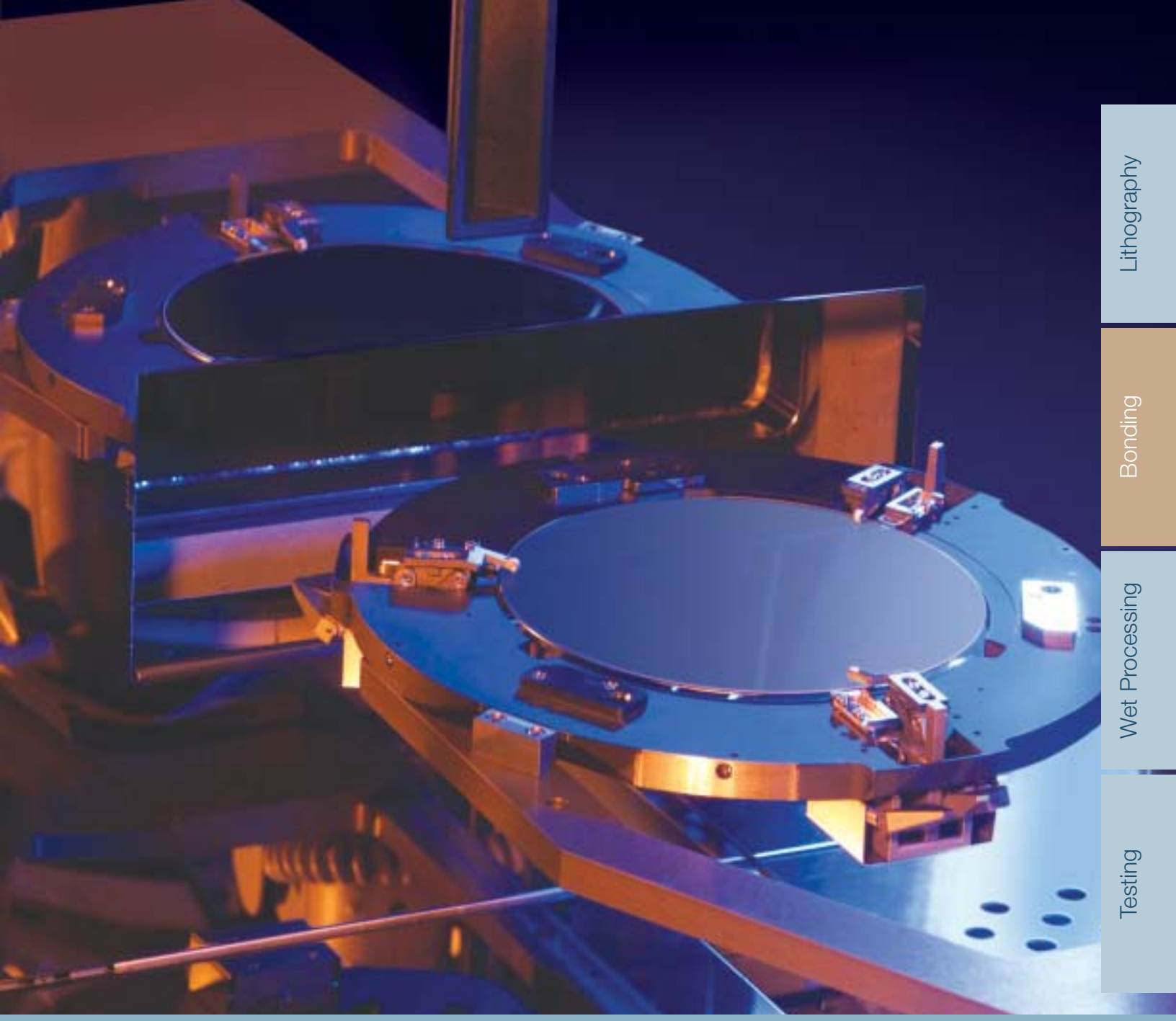

Lithography

Bonding

Wet Processing

Testing

HIGH PRECISION SUBSTRATE BONDERS

SB 6e
SUBSTRATE BONDER

SB 8e
SUBSTRATE BONDER

SÜSS MicroTec

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HIGHEST PRECISION SUBSTRATE BONDERS

Bonding represents the final step in the process sequence in which multiple wafers or substrates are attached together either permanently or temporarily using any number of adhesive technologies. SUSS' philosophy is to maintain a completely flexible and modular system architecture where wafers travel through process modules via a high precision transport fixture.

The SB8e and the SB6e (SB8e/6e) represent the latest generation technology in substrate bonders offering precision performance and flexibility in a user-friendly, high-quality package.

The newly designed and enhanced SB8e/6e are semi-automatic, computer-controlled systems with both vacuum- and pressure-controlled atmosphere capability featuring an ergonomic load/unload station. The SB8e/6e delivers superior post bond alignment accuracy resulting from precision mechanics, uniform force capability and leading temperature control. When matched with SUSS' bond aligners, BA8/6, they offer enabling capability for MEMS, 3-D interconnects, and opto-electronics.

This generation's bond chamber and tooling supports all types of bond processes with optimization especially for thermo-compression bonding and the flexibility to switch to anodic bond tooling. The flexibility of these bond systems make them ideal and economical for laboratories and small series production. Yet, combined with SUSS' patent-pending low temperature plasma activation module these systems offer enabling technology for fusion bonding of SOI, III/V, and SiGe compounds at temperatures down to 200°C.

Features and Benefits

ENABLING TECHNOLOGY

- *Up to 1µm post bond alignment capability allows better yield and opens up new applications*
- *Independent top and bottom heaters compensates for different thermal mismatch delivering optimized bond quality*
- *Active cooling and fast heating significantly reduces process cycle times*
- *Controlled bond chamber atmosphere (pressure and/or vacuum) allows tuning of the device performance — enhancing final yield*
- *Unique gate valve-type load/unload port minimizes chamber exposure to the atmosphere and eliminates chamber contamination resulting from "top loading"*

FLEXIBILITY

- *Configurable for 200 mm and smaller wafer sizes and stack thicknesses up to 6 mm allows conversion capability as wafer dimensions changes*
- *One chamber designed for all types of bond processes reduces capital investment over the widest range of process conditions*
- *Standardized wafer-transport technology allows easy transfer from one process module to another*
- *Options for triple-stack bonding and hot embossing*

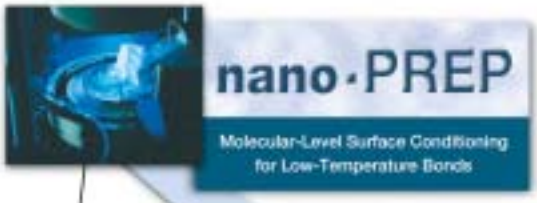
EASE OF USE

- *User-friendly Windows-based graphical software is intuitive and easily used in minutes*
- *Ergonomic load/unload station which safely separates the user from the heater/pressure/voltage systems inside the chamber*
- *Designed and manufactured to SEMI S2, S8 Guidelines, European CE marking requirements, NFPA 79, and National Electric Code (NEC/NFPA 70) allowing straightforward worldwide installation*

The SUSSolution for a perfect bond

Modularity and Flexibility from a single manufacturer

Cleaning Module



CL200 Cleaner

CLEANING

The SUSS CL200 removes particles and contaminants from substrates prior to bonding allowing for direct contact between the substrates.

ACTIVATION

SUSS' surface activation technology lowers the energy required to achieve optimum bond strength for SOI-type bonding.

ALIGNMENT

Precise alignment is the key to successful high accuracy wafer bonding. In combination with the laser pre-bond option on the bond aligner the system is capable of < 1 µm post bond alignment accuracy.

BOND

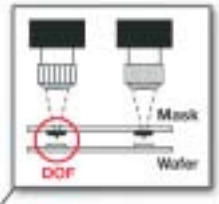
The final bond is achieved in the substrate bonder. The module has been designed to meet the most advanced substrate bonding requirements with precision temperature, pressure and atmosphere control over the entire bond process.

PRODUCTION

The fully automated, cassette to cassette ABS200e/150e utilizes the technology and tooling of the SB8e/6e allowing easy recipe transfer to high volume production.

BA8/6 Bond/Aligner

Alignment Module



Transport Fixture

TRANSPORT

The process modules are linked by the unique SUSS transport fixture, which features automatic clamping, and spacers for gap control. The fixture ensures that high alignment accuracy is maintained through to final bond.

Bond Module

SB8e/6e Substrate Bonder

Production Level Bonding

ABS200e/150e Bond Cluster

SB 8e SUBSTRATE BONDER

SB 6e SUBSTRATE BONDER

Bond Processes

- Anodic Bonding
- Eutectic Bonding
- Glass Frit Bonding
- Fusion Bonding (post bond annealing required)
- Thermo-compression
- SOI Bonding
- Adhesive Bonding (various adhesives)
- Temporary Bonding Applications

Low Temperature Methodologies

- Eutectic Bonding
- Fusion Bonding (post bond annealing required) Ambient pressure plasma activation reduces annealing from 1000° C to as low as 200° C
- Thermo-compression
- Adhesive Bonding (photo definable), Benzocyclobutene (BCB), SU8 resist

The Bond Chamber

The unique SB8e/6e bond chamber supports both vacuum and pressurized ambient up to 3 bar. Independent temperature control of top and bottom wafers compensates for different thermal expansion coefficients and provide optimized bond quality. Active cooling maximizes throughput. A small gate valve-type load/unload port minimizes chamber exposure to the environment and operator contamination of bond tooling and chamber.

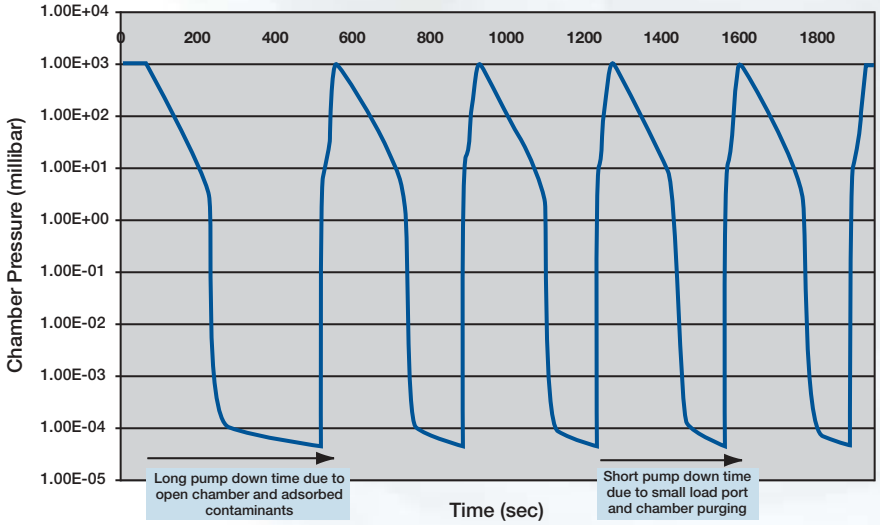
Bond Force Control

A repeatable and uniform pressure on the wafers is accomplished using a unique feedback control system to insure that the bond pressure is consistent and independent of the chamber pressure/vacuum.

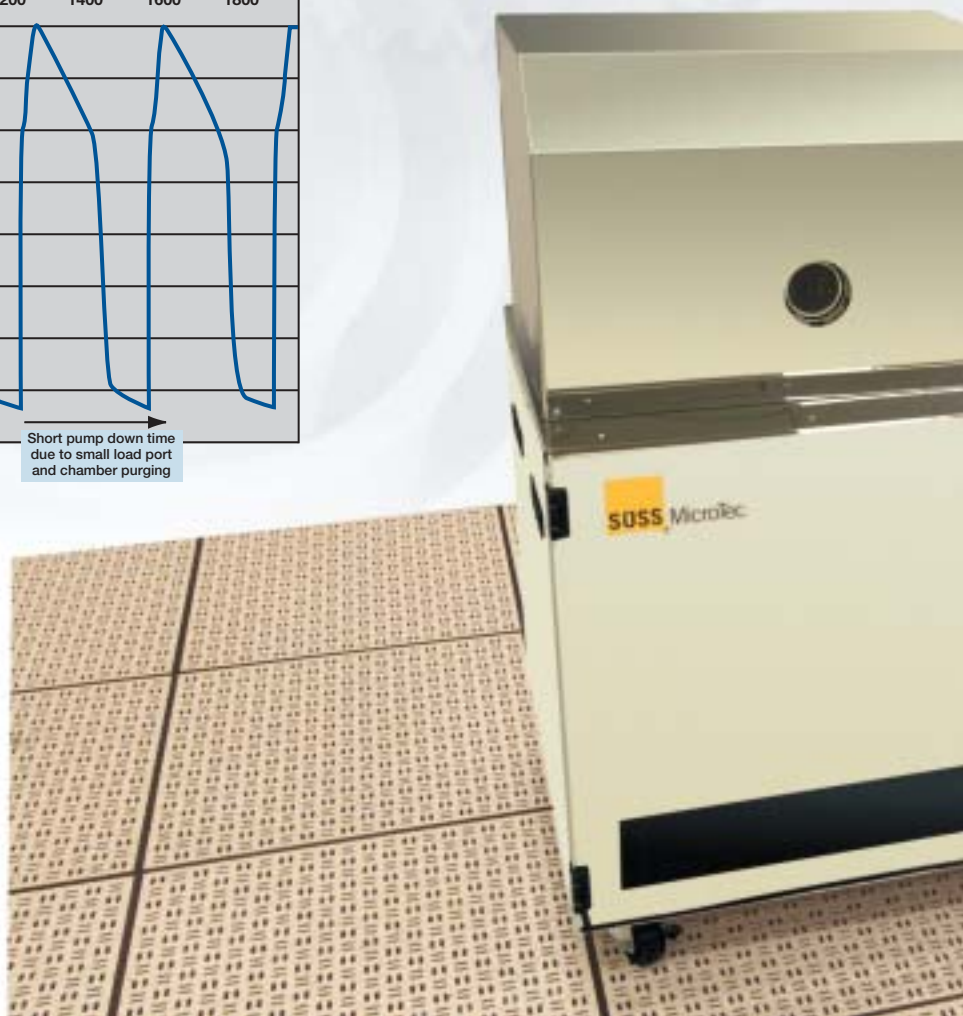
Bond Pressure	Repeatability (mbar)	Repeatability (%)
1000 millibar	2.0	0.2%
4500 millibar	2.6	0.1%
9000 millibar	9.9	0.1%
Total Repeatability (full scale)	5.9	0.1%
Total Repeatability 3 sigma (full scale)	17.7	0.2%

Example of bond force repeatability measured at low, medium and high bond pressures

Vacuum Pumpdown

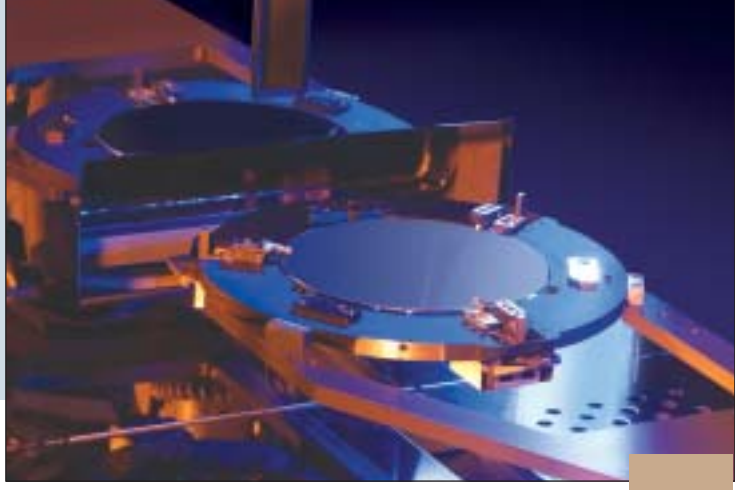


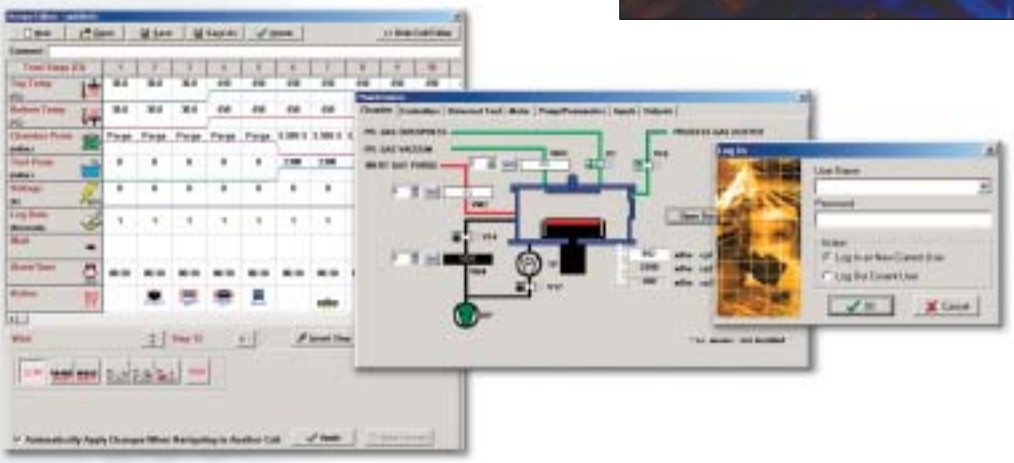
A vacuum chamber significantly exposed to air experiences delays in reaching high vacuum due to adsorbed moisture and contaminants. SUSS' small gate valve load/unload port and chamber purging helps minimize this effect.

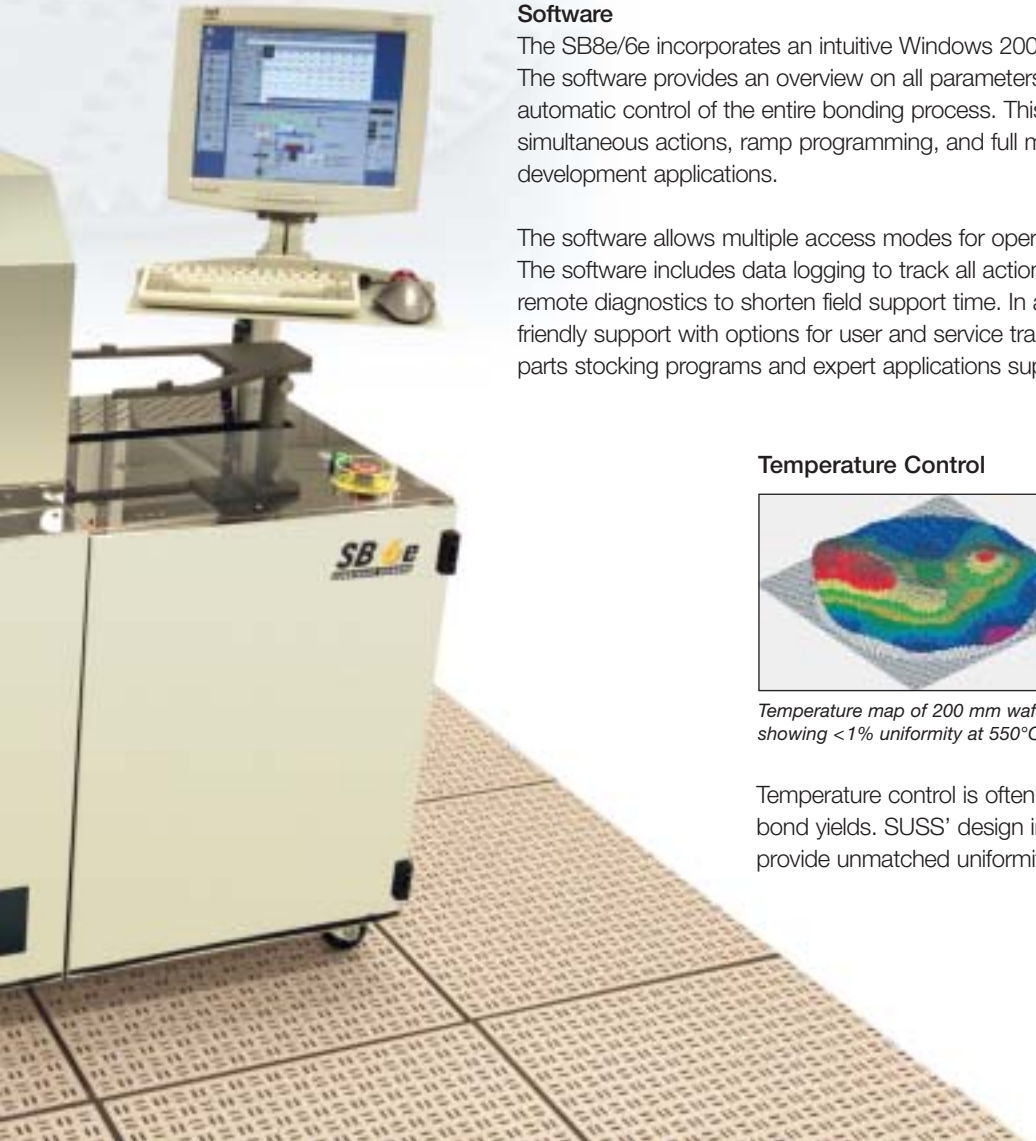


Material Handling Unit

The SB6e is equipped with an ergonomic loading slide which safely separates the user from the heater/pressure/voltage systems inside the chamber. The fixture enters the chamber through a small load port, preventing chamber and wafer contamination common with top loading systems.





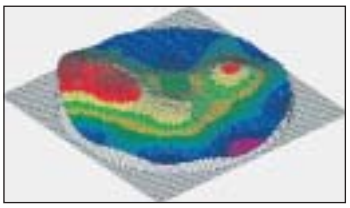


Software

The SB8e/6e incorporates an intuitive Windows 2000®-based graphical user interface. The software provides an overview on all parameters at a glance and enables fully automatic control of the entire bonding process. This includes automatic error checking, simultaneous actions, ramp programming, and full manual processing for research and development applications.

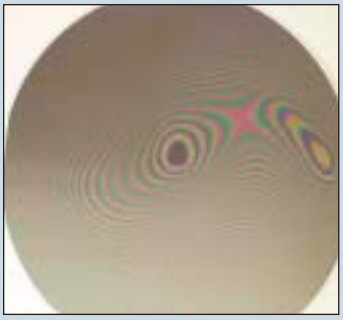
The software allows multiple access modes for operators, engineers and service personnel. The software includes data logging to track all actions and responses in the tool and remote diagnostics to shorten field support time. In addition SUSS provides customer friendly support with options for user and service training, 24/7 on-site service staff, spare parts stocking programs and expert applications support.

Temperature Control

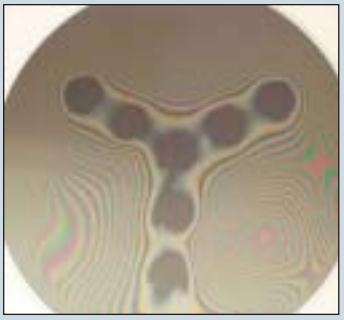


Temperature map of 200 mm wafer showing <1% uniformity at 550°C

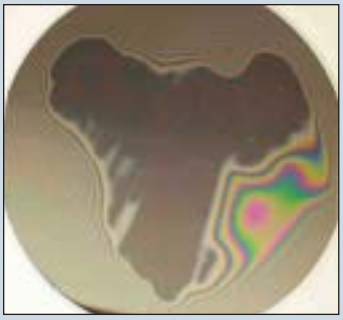
Temperature control is often critical to achieving consistently high bond yields. SUSS' design incorporates the latest technologies to provide unmatched uniformity, accuracy and repeatability.



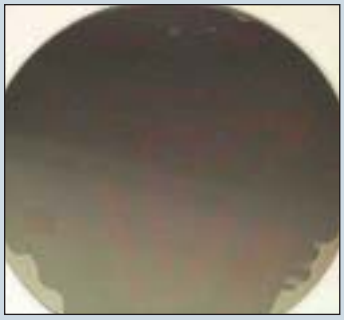
After 5 seconds.



After 20 seconds.



After 2.5 minutes.



After 8 minutes.

Bond example using SUSS' Star-shaped electrode and blank 100mm wafers

SUSS Bond Tool Concept Key to High Yield and Throughput

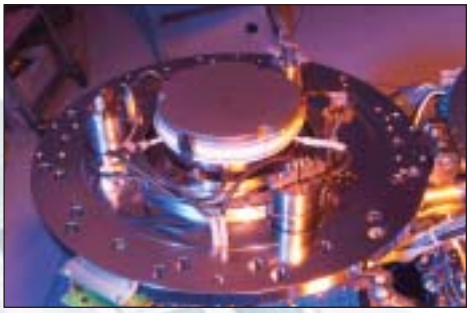
Universal Bond Tools
A series of Universal Bond Tools combines anodic and thermo-compression capabilities in one unit. A center push-pin presses the wafers together thus maintaining the alignment accuracy in spite of thermal expansion. Disposable and exchangeable plates eliminate the effects of sodium migration during anodic bonding, and also allow for flexibility in substrate size. Adaptations allow for single chip bonding.

Star Shaped Electrode
SUSS' patented Star Shaped Electrode represents the ultimate technology for anodic bonding making void-free anodic bonding possible — even in atmosphere.

Thermo-compression Tool
The Thermo-compression Tool offers excellent temperature uniformity and enables the highest demonstrated post bond alignment accuracy in a production environment. The tool provides an optimized bond force uniformity, achieving a maximum bond force of up to 20kN.

Universal Bond Tool (UniTool) for all types of thermo-compression and anodic process developments

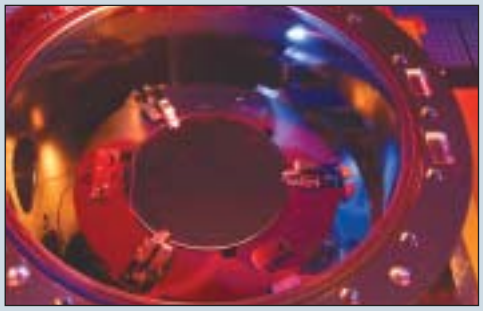
Star-Shaped Electrode for anodic bonding



Thermo-compression Bond Tool optimized for high yield thermo-compression bonds

TECHNICAL DATA SB8e AND SB6e

Base Machine	
SUSS SB8e/6e Substrate Bonders	Semiautomatic, computer-controlled stand-alone bonder with environmentally isolated, programmable bond chamber; and material handling unit
General Bonding Capability	For aligned and unaligned wafers, substrates and chips also for triple and multiple stacks using thermo-compression, anodic, fusion, adhesive or any related bond technology
Wafer and Substrate Size	SB8e: 200 mm and 150 mm ø; SB6e: 150 mm ø to 10 mm x 10 mm
Aligned Bonding	Down to 3 µm bond accuracy depending on process conditions Down to 1 µm with Laser prebond option in BA8/6
Upgrade Capability	A stand-alone cluster module with similar specification, is available for subsequent upgrade to automatic wafer handling
Controllers and Software	
Programming	Flexible Windows 2000® based user interface with graphical recipe editor, multiple user access levels, service, calibration and configuration programs, process and data log files
Computer	High-speed Pentium®-type or similar with 15" color monitor
TCP/IP Network	Ethernet 10/100 Base T or similar
Data Recording	ASCII file with time, temperatures, bond pressure, chamber pressure, voltage, current, break condition
Utilities	
Vacuum	90-95 millibar @ 16.7 slpm, 8 mm OD tubing
Compressed Air	CDA at 6-10 bar @ 16.7 slpm–configuration dependent; filtered to < 40 micron, oil-free, 8 mm OD tubing
Nitrogen	7-7.5 bar @ 8.4 slpm; filtered to < 40 micron, oil-free, 8 mm OD tubing
Exhaust	10.6 cfm @ 0.21 millibar; 2" OD heat resistant connection (to 350ºC)
Power Requirements	208 – 230 VAC, 50/60 Hz; 20A; 4200W
Dimensions and Weight	1200 mm / 625 mm / 1400 mm (Length/Depth/Height); 340 kg
Installation Recommendation	Cleanroom class 100 or better–process dependent, 20-22ºC, 40-45% RH, vibration isolation floor. Adjacent area, separate from machine for vacuum pumps.
Regulations and Standards	SEMI S2-93A Safety Guidelines, SEMI S1-90 (Visual Hazard Alerts), SEMI S8-95 (Ergonomics) EU Low Voltage Directive, EU Machinery Directive, EU EMC Directive National Electric Code (NEC/NFPA 70), NFPA 79 (Industrial Machinery) ANSI Z535.4 (Safety Guidelines for Semiconductor Eq.), OSHA (29CFR 1910.144-149)



Data, design and specification of custom built machines depend on individual process conditions and can vary according to equipment configurations. Not all specifications may be valid simultaneously. Illustrations in this brochure are not legally binding. SUSS reserves the right to change machine specifications without prior notice.

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