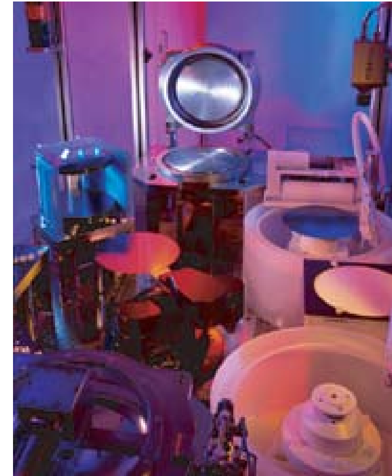
Stand–Alone Plasma Activation Tool

The stand-alone plasma-activation (SPA) tool is a small footprint tool designed to provide a reactive surface to bond silicon wafers and heterogeneous substrates. The plasma technology utilizes proprietary dual-frequency RF sources to activate wafer substrates prior to bonding. The stand-alone system allows the integration of SiGen's PA benefits for high yield and throughput substrate production using non-plasma bond equipment.

The SiGen PA tool allows room-temperature bonding with 80% of bulk covalent bond strength.

Plasma Activation offers room-temperature bonding with a bond strength up to 80% of bulk silicon (i.e., 80% of the force necessary to pull a silicon wafer apart at any lattice plane). A short, relatively low-temperature anneal brings the bond strength to 100% of bulk silicon.

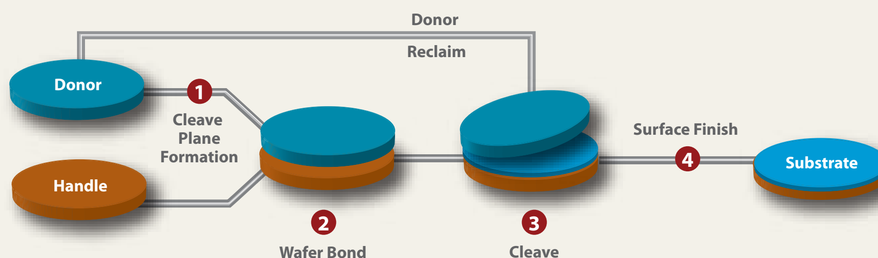


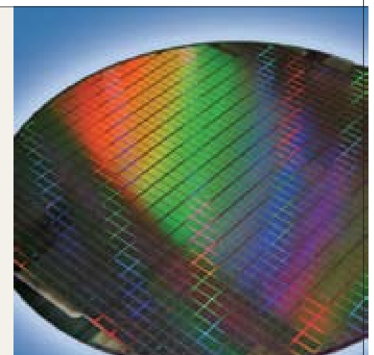
The SiGen Plasma Activation Chamber (open, in background) is shown here incorporated into an EV850 cluster tool.

The process chamber is a dual-frequency parallel plate reactor that consists of top and bottom parallel plate electrodes. The top electrode serves as the "source" electrode with the bottom electrode as the "bias" electrode. Each electrode is connected to an RF generator via an RF match. The top lid swings open on a hinge assembly to allow for wafer introduction into and retrieval from the chamber. At the bottom of the chamber body, there are an exhaust port and inlet for process gas. Mass Flow Controllers (MFC) regulate the gas flow.

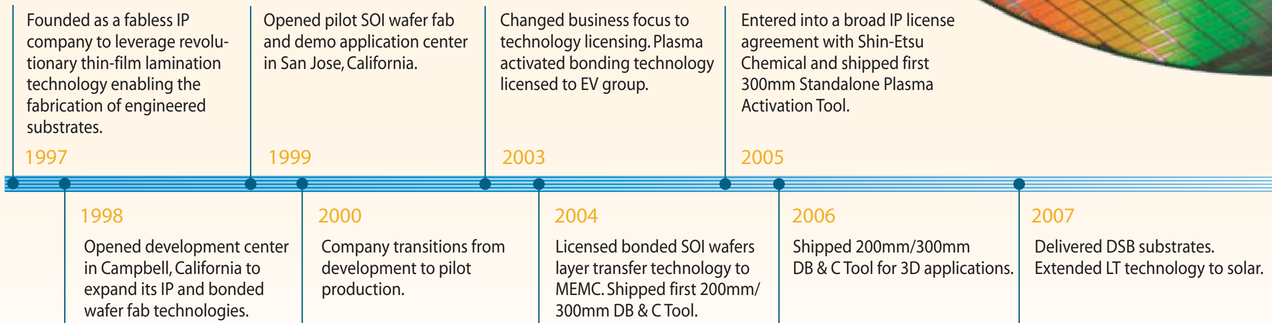
The electronics components are housed in a separate control rack.

Process Technology





SiGen History



SPA Tool Specs

Major Features:

- Low cost of ownership
- Ability to attain full strength bonds below 300°C
- Broad range of materials compatibility
- Custom surface termination
- Applicable to SOI wafer manufacturing, bonding compound
- Semiconductors and for MEMS device fabrication and packaging.

General Specifications

Substrate size:	200mm and 300mm
Thickness *(single wafer)*:	725μm and 775μm

Operating Conditions

Chamber pressure:	25-50mT base pressures
Wafer temperature:	Ambient (before plasma is turned on)
Plasma ON:	10 to 30 sec
RF power:	0 to 500 W
Reflected power:	< 20W

Facilities Requirements

Footprint:	39"W x 39"D x 94"H
Clean room:	Class 1 mini-environment
Power:	208 VAC, 60Hz, 30 amps, 3 Phase
Vacuum pump:	BOC Edwards QDP 40
RF generators:	Power – 198-250 VAC, 50/60Hz, 1 phase 6 amps; Cooling – 0.5 GPM minimum facilities water, 20°C inlet temperature
RF matches:	Power – 100 VAC, 50/60Hz, 1 amp. Cooling – forced air
Process gas:	25 LPM maximum; 8-20 psig

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Applications

SOI (silicon-on-insulator) Used to reduce device voltage operation and power consumption, improve device speed.

DSB (direct silicon bond) Improved device mobility in CMOS circuitry by providing separate crystal orientation layers for NMOS and PMOS.

SOQ (silicon-on-quartz) Transferred single-crystal silicon onto a quartz substrate used for RF, display and optical applications.

SOG (silicon-on-glass) Transferred single-crystal silicon onto bulk glass enabling low-cost, high-efficiency solar cells, displays, and optical applications.

CSS (customer-specific-substrate) A combination of donor-layer materials on unique handle substrates, including III-V and II-VI donor materials and sapphire, ceramics, and flexible handle substrates.

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