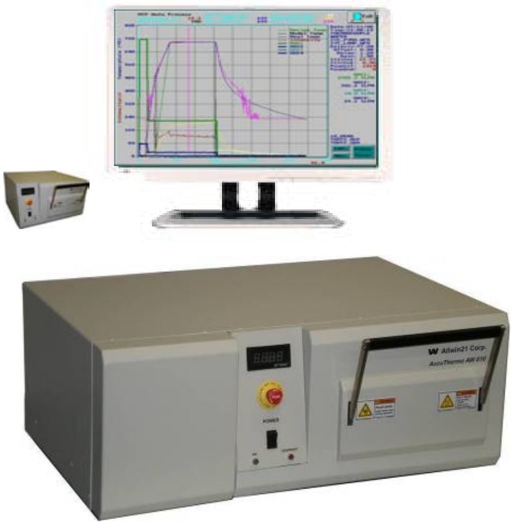
Rapid Thermal Process

ALLLWIN21 CORP.



AccuThermo AW 610

Introduction

The AccuThermo AW610 was derived from the AG Associates 610 production-proven design. Allwin21 Corp. is the *exclusive* manufacturer of the AG Associates Heatpulse 610 desktop atmospheric RTP (Rapid Thermal Processing) system. The system uses high intensity visible radiation to heat single wafer for short process periods of time at precisely controlled temperatures. The process periods are typically 1-600 seconds in duration, although periods of up to 9999 seconds can be selected. These capabilities, combined with the heating chamber's cold-wall design and superior heating uniformity, provide significant advantages over conventional furnace processing.

AccuThermo AW 610 Key Features

- 35 years' production-proven Real RTP/RTA/RTO/RTN system.
- Scattered IR light by special gold plated Al chamber surface.
- Allwin21 advanced Software package with real time control technologies and many useful functions.
- Consistent wafer-to-wafer process cycle repeatability.
- Top and bottom High-intensity visible radiation Tungsten halogen lamp heating for fast heating rates with good repeatability performance and long lamp lifetime.
- Cooling N2 (Or CDA) flows around the lamps and quartz isolation tube for fast cooling rates
- Elimination of external contamination by Isolated Quartz Tube
- Up to six gas lines with MFCs and shut-off valves
- Energy efficient.
- Made in U.S.A.
- Small footprint

Gas Line(s)	1	2 to 4	5 to 6
Dimension(DXWXH)	17"x18"x11"	17"x26"x11"	17"x30"x11"

Typical Application Areas:

- Chip manufacture
- Compound industry: GaAs,GaN,GaP,GaINP,InP,SiC, III-V,II-VI
- Optronics, Planar optical waveguides, Lasers
- Nanotechnology
- Biomedical
- Battery
- MEMS
- Solar
- LED

Typical Applications (But not limited to)

- Silicon-dielectric growth
- Implant annealing
- Glass reflow
- Silicides formation and annealing
- Contact alloying
- Nitridation of metals
- Oxygen-donor annihilation
- Other heat treatment process

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AccuThermo AW 610 Software Key Features

- o Integrated process control system
- o Real time graphics display
- o Real time process data acquisition, display, and analysis
- o Programmed comprehensive calibration and diagnostic functions
- o Closed-loop temperature control with temperature sensing.
- o Precise time-temperature profiles tailored to suit specific process requirements.
- o Faster, easier Programmable comprehensive calibration of all subsystems, leading to enhanced process results.
- o A recipe editor to create and edit recipes to fully automate the processing of wafers inside the AccuThermo RTP
- o Validation of the recipe so improper control sequences will be revealed.
- o Storage of multiple recipes, process data and calibration files so that process and calibration results can be maintained and compared over time.
- o Passwords provide security for the system, recipe editing, diagnostics, calibration and setup functions.
- o Simple and easy to use menu screen which allow a process cycle to be easily defined and executed.
- o Troubleshooting feature which allows engineers and service personnel to activate individual subassemblies and functions. More I/O, AD/DA "exposure".
- o Use PowerSum technology to detect the process and increase Yield.
- o Watchdog function: If this board looses communication with the control software, it will shut down all processes and halt the system until communication is restored.
- o GEM/SECS II function (Optional).

AccuThermo AW 610 Specifications

- ❖ Wafer sizes: Small pieces, 2", 3", 4", 5", 6" wafer capability
- ❖ Recommended ramp up rate: Programmable, 10°C to 120°C per second. Maximum Rate: 200°C (NOT RECOMMENDED)
- ❖ Recommended steady state duration: 0-300 seconds per step.
- ❖ Ramp down rate: Non-programmable, 10°C to 200°C per second.
- ❖ Recommended steady state temperature range: 150°C - 1150°C. Maximum 1250°C (NOT RECOMMENDED)
- ❖ ERP Pyrometer 450-1250°C with ±1°C accuracy when calibrated against an instrumented thermocouple wafer.
- ❖ Thermocouple 100-800°C with ±0.5°C accuracy & rapid response.
- ❖ Temperature repeatability: ±0.5°C or better at 1150°C wafer-to-wafer. (Repetition specifications are based on a 100-wafer set.)
- ❖ Temperature uniformity: ±5°C across a 6" (150 mm) wafer at 1150°C. (This is a one sigma deviation 100 angstrom oxide.) For a titanium silicide process, no more than 4% increase in non-uniformity during the first anneal at 650°C to 700°C.
- ❖ Process/Purge gas inputs: Any inert and/or non-toxic gas regulated to 30 PSIG and pre-filtered to 1 micron. Typically, N_2, O_2, Ar, He, forming gas, NH_3, N_2O_2 are used.

AccuThermo AW 610 Configuration

- ■ AccuThermo AW 610 Main Frame with wires.
- ■ Power Type: Three Phase, worldwide power (50/60 Hz)
- ■ CE Mark if Necessary
- ■ Pentium® class computer with a 17-inch LCD monitor and Allwin21 Corp proprietary software package.
- ■ Mouse and standard keyboard.
- ■ Aluminum oven chamber with water cooling passages and gold plating plates.
- ■ Door plate with one TC connection port.
- ■ Isolated Quartz Tube W/O Pyrometer window or with Pyrometer Window.
- ■ Oven control board and one main control board.
- ■ Bottom and top heating with 21 (1.2KW ea) Radiation heating lamp module with 4 bank zones (Top Front&Rear, Bottom Front&Rear).
- ■ Quartz Tray for 4 to 6 inch round wafer or customized.
- ■ Gas line with Gas MFC without shut-off valve.
- ■ T-Shape Quartz with qualified K-Type TC and one set holder for 100-800°C temperature measurement.
- ■ Package of 5 pieces of thermocouple wires as spare TC
- ■ USB with original Software backup.

Options:

- ◆ Multiple Process Gases (Up to 6) and MFCs with Extended Gas Box and Gas Control Board
- ◆ Carrier or Susceptor for small sample, transparent substrate and substrate with metal thin film on top.
- ◆ Patented ERP Pyrometer (400-1250°C) as non-contact high temperature sensor.
- ◆ Chiller for ERP Pyrometer
- ◆ 2-inch, 4-inch, 6-inch TC Wafer, Single Point for Pyrometer calibration
- ◆ Omega Meter for Pyrometer and Thermocouple calibration
- ◆ Shutt-off valve for Quartz Tube & Lamps cooling control
- ◆ Spare Parts

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All specification and information here are subject to change without notice and cannot be used for purchase and facility plan.

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Rapid Thermal Process Introduction

Allwin21 Corp. is the exclusive licensed manufacturer of AG Associates Heatpulse 610 Rapid Thermal Processing equipment. Allwin21 is manufacturing the new AccuThermo AW Series Atmospheric Rapid Thermal Processors and Vacuum Rapid Thermal Processors. Compared with traditional RTP systems, Allwin21's AccuThermo AW RTPs have innovative software and more advanced temperature control technologies to achieve the BEST rapid thermal processing performance (repeatability, uniformity, and stability) with decades of research directly applicable to ours.

For many years AG Associates was the dominant manufacturer of RTP systems. It was founded in 1981 and produced the first single wafer RTP system in 1982, the Heatpulse 210. In 1987, it produced the Heatpulse 610. These RTP systems run at atmospheric pressure and rely on a pre-process nitrogen or argon purge prior to wafer processing. They are still being used around the world in manufacturing, R&D and Universities. These RTP systems have a proven track record for reliability and simplicity.

Rapid thermal processing (or RTP) refers to a semiconductor manufacturing process which heats silicon wafers to high temperatures (up to 1250°C) on a timescale of several seconds or less. The wafer's temperature must be brought down slow enough however, so they do not break due to thermal shock… Such rapid heating rates are attained by high intensity lamps process. These processes are used for a wide variety of applications in semiconductor manufacturing including dopant activation, thermal oxidation, metal reflow and chemical vapor deposition.

Rapid thermal anneal (RTA) is a process used in semiconductor device fabrication which consists of heating a single wafer at a time in order to affect its electrical properties. Unique heat treatments are designed for different effects. Wafers can be heated in order to activate dopants, change film-to-film or film-to-wafer substrate interfaces, densify deposited films, change states of grown films, repair damage from ion implantation, move dopants or drive dopants from one film into another or from a film into the wafer substrate. Rapid thermal anneals are performed by equipment that heats a single wafer at a time using lamp based heating that a wafer is brought near. Unlike furnace anneals they are short in duration, processing each wafer in several minutes. Rapid thermal anneal is a subset of processes called Rapid Thermal Process (RTP).

Rapid thermal processing (RTP) provides a way to rapidly heat wafers to an elevated temperature to perform relatively short processes, typically less than 1-2 minutes long. Over the years, RTP has become essential to the manufacture of advanced semiconductors, where it is used for oxidation, annealing, silicide formation and deposition.

An RTP system heats wafers singly, using radiant energy sources controlled by a pyrometer that measures the wafer's temperature. Previous thermal processing was based on batch furnaces, where a large batch of wafers is heated in a tube. Batch furnaces are still widely used, but are more appropriate for relatively long processes of more than 10 minutes.

RTP is a flexible technology that provides fast heating and cooling to process temperatures of ~200-1250°C with ramp rates typically 20-200°C/sec, combined with excellent gas ambient control, allowing the creation of sophisticated multistage processes within one processing recipe. This capability to process at elevated temperatures for short time periods is crucial because advanced semiconductor fabrication requires thermal budget minimization to restrict dopant diffusion. Replacement of the slower batch processes with RTP also enables some device makers to greatly reduce manufacturing cycle time, an especially valuable benefit during yield ramps and where cycle-time minimization has economic value.

RTP systems use a variety of heating configurations, energy sources and temperature control methods. The most widespread approach involves heating the wafer using banks of tungsten-halogen lamps because these provide a convenient, efficient and fast-reacting thermal source that is easily controlled. In a typical RTP system , the wafer is heated by two banks of linear lamps — one above and one below it. The lamps are further subdivided into groups or zones that can be individually programmed with various powers to maximize temperature uniformity. In RTP, the energy sources face the wafer surfaces rather than heating its edge, as happens in a batch furnace. Thus, RTP systems can process large wafers without compromising process uniformity or ramp rates. RTP systems frequently incorporate the capability to rotate the wafer for better uniformity.

An important RTP application is the activation of ion-implanted dopants to form ultrashallow junctions. This requires fast ramp and cooling capabilities because the wafer must be heated to ~1050°C to anneal out ion implantation damage and activate the implanted dopant species. However, the time at temperature must be reduced to minimize diffusion. This has led to the spike-anneal approach, where the wafer is ramped to a high temperature and then cooled immediately.

Another indispensable RTP application is in the formation of silicides. In this process, metal films react with the silicon on source/drain and gate regions to form silicides. In advanced logic processes, the metal is usually cobalt, but nickel is being explored for the 65 nm node. Silicide formation processes are usually performed at <500°C, and wafers must be kept in a very pure gas ambient because metal films can be sensitive to oxidation. RTP systems are ideal, because they have small chamber volumes easily purged with high-purity gas, creating a very clean environment.

RTP is also increasingly important in oxidation applications, where the capability to use short process times at high temperatures and a wide variety of gas ambients provides excellent quality films and superior process control. RTP-grown oxides are often used for gate dielectrics, tunnel oxides and shallow-trench isolation liners. The use of steam in the gas ambient has opened new RTP applications. One of special interest for advanced DRAM technology is the use of a hydrogen-rich steam ambient for selective oxidation of gate stacks that include tungsten.

Some solar cell companies have successfully applied our advanced Rapid Thermal Processing (RTP) technology to its process for creating highly efficient and durable CIGS solar cells. This eliminates a key process bottleneck found in many state-of-the-art process implementations and enables the use of low-cost substrates in ways that were not considered possible before.

In Rapid Thermal Processing, a layer is heated for a very brief period only in a highly controlled way. For instance, RTP techniques can flash-heat a layer for just several picoseconds and put energy just into the top several nanometers of a layer in a highly controlled way — while leaving the rest of the layer unaffected.

RTP has a secondary benefit of reducing the energy payback time of their solar cells to less than two months (for the full panel). By comparison, a typical silicon solar panel has an energy payback time of around three years, and a typical vacuum-deposited thin-film cell has one of 1-2 years. The energy payback time is the time that a solar panel has to be used in order to generate the amount of energy that it required to be produced.