CLAIMS

1. A method for cleaning substrate without damaging patterned structure on the substrate using ultra/mega sonic device, comprising:

applying liquid into a space between a substrate and an ultra/mega sonic device;

setting an ultra/mega sonic power supply at frequency f_1 and power P_1 to drive the ultra/mega sonic device;

before bubble cavitation in the liquid damaging patterned structure on the substrate, setting the ultra/mega sonic power supply at zero output;

after temperature inside bubble cooling down to a set temperature, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 again;

detecting power on time at power P1 and frequency f1 and power off time separately;

comparing the detected power on time at power P1 and frequency f1 with a preset time τ_1, if the detected power on time is longer than the preset time τ_1, shut down the ultra/mega sonic power supply and send out an alarm signal;

comparing the detected power off time with a preset time τ_2, if the detected power off time is shorter than the preset time τ_2, shut down the ultra/mega sonic power supply and send out an alarm signal;

repeating above steps till the substrate being cleaned.

2. The method of claim 1, wherein detecting power on time at power P1 and frequency f1 and power off time separately, comprises:

attenuating amplitude of the waveform output by the ultra/mega sonic power supply;

converting sinusoidal wave of which amplitude is attenuated into square wave;

converting pulse signal of the power on time to high level signal, and the low level signal of power off time remaining the same;

measuring the time of high level and low level for comparing with the preset time τ_1 and the preset time τ_2.

3. The method of claim 2, wherein the attenuation rate is set in the range of 5 to 100.

4. The method of claim 1, wherein the actual power on time is equal to τ-τ_3, wherein τ is the measured time of high level, τ_3 is the time of the ultra/mega sonic power supply oscillating several periods after the ultra/mega sonic power supply is shut down.

5. The method of claim 4, wherein comparing the detected power on time at power P1 and frequency f1 with a preset time τ_1, if the detected power on time is longer than the preset time τ_1, shut down the ultra/mega sonic power supply and send out an alarm signal, comprises:

comparing the actual power on time with the preset time τ_1, if the actual power on time is longer than the preset time τ_1, shut down the ultra/mega sonic power supply and send out an alarm signal.

6. A method for cleaning substrate without damaging patterned structure on the substrate using ultra/mega sonic device, comprising:

applying liquid into a space between a substrate and an ultra/mega sonic device;

setting an ultra/mega sonic power supply at frequency f_1 and power P_1 to drive the ultra/mega sonic device;

before bubble cavitation in the liquid damaging patterned structure on the substrate, setting the ultra/mega sonic power supply at zero output;

after temperature inside bubble cooling down to a set temperature, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 again;

detecting amplitude of each waveform output by the ultra/mega sonic power supply;

comparing detected amplitude of each waveform with a preset value, if the detected amplitude of any waveform is larger than the preset value, shut down the ultra/mega sonic power supply and send out an alarm signal, wherein the preset value is larger than waveform amplitude at normal operation;

repeating above steps till the substrate being cleaned.

7. The method of claim 6, further comprising:

attenuating amplitude of the waveform output by the ultra/mega sonic power supply;

obtaining analog DC reference voltages V_{ref+} and V_{ref-};

comparing the attenuated amplitude V_{in} with the reference voltages V_{ref+} and V_{ref-}, if the attenuated amplitude V_{in} exceeds the reference voltages V_{ref+} and V_{ref-}, shut down the ultra/mega sonic power supply and send out an alarm signal.

8. An apparatus for cleaning semiconductor substrate using ultra/mega sonic device, comprising:

a chuck, holding a semiconductor substrate;

an ultra/mega sonic device, being positioned adjacent to the semiconductor substrate;

at least one nozzle, injecting chemical liquid on the semiconductor substrate and a gap between the semiconductor substrate and the ultra/mega sonic device;

an ultra/mega sonic power supply;

a host computer, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 to drive the ultra/mega sonic device, before bubble cavitation in the liquid damaging patterned structure on the semiconductor substrate, setting the ultra/mega sonic power supply at zero output, after temperature inside bubble cooling down to a set temperature, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 again;

a detection system, detecting power on time at power P1 and frequency f1 and power off time separately, comparing the detected power on time at power P1 and frequency f1 with a preset time τ_1, if the detected power on time is longer than the preset time τ_1, the detection system sends out an alarm signal to the host computer, and the host computer receives the alarm signal and shuts down the ultra/mega sonic power supply, comparing the detected power off time with a preset time τ_2, if the detected power off time is shorter than the preset time τ_2, the detection system sends out an alarm signal to the host computer, and the host computer receives the alarm signal and shuts down the ultra/mega sonic power supply.

9. The apparatus of claim 8, wherein the detection system includes a voltage attenuation circuit, a shaping circuit, a main controller, a communication circuit and a power circuit.

10. The apparatus of claim 9, wherein the voltage attenuation circuit reduces the amplitude value of the waveform output by the ultra/mega sonic power supply.

11. The apparatus of claim 10, wherein the attenuation rate of the voltage attenuation circuit is set in the range of 5 to 100.

12. The apparatus of claim 9, wherein after the waveform passing the voltage attenuation circuit, the waveform (sinusoidal wave) is input to the shaping circuit, the shaping circuit converts the sinusoidal wave into square wave.

13. The apparatus of claim 9, wherein the main controller includes a pulse conversion module and a periodic measurement module, the pulse conversion module converts the pulse signal of τ_1 time to the high level signal, and the low level signal of τ_2 time remains the same, the periodic measurement module measures the time of high level and low level by means of counter.

14. The apparatus of claim 9, wherein the main controller compares the measured power on time with the preset time τ_1, if the measured power on time is longer than the preset time τ_1, the main controller sends out the alarm signal to the host computer, the main controller compares the measured power off time with the preset time τ_2, if the measured power off time is shorter than the preset time τ_2, the main controller sends out the alarm signal to the host computer.

15. The apparatus of claim 13, wherein the actual power on time is equal to τ-τ_3, where τ is the time measured by the periodic measurement module, τ_3 is the time of the ultra/mega sonic power supply oscillating several periods after the host computer shuts down the ultra/mega sonic power supply, the main controller compares the actual power on time with the preset time τ_1, if the actual power on time is longer than the preset time τ_1, the main controller sends out the alarm signal to the host computer.

16. The apparatus of claim 9, wherein the communication circuit is established as an interface to the host computer, the communication circuit realizes RS232/RS485 serial communication with the host computer.

17. The apparatus of claim 9, wherein the power circuit converts DC15V to a target voltage.

18. The apparatus of claim 8, wherein the ultra/mega sonic device is further coupled with the nozzle and positioned adjacent to the semiconductor substrate, the energy of the ultra/mega sonic device is transmitted to the semiconductor substrate through the liquid column out of the nozzle.

19. An apparatus for cleaning semiconductor substrate using ultra/mega sonic device, comprising:

a chuck, holding a semiconductor substrate;

an ultra/mega sonic device, being positioned adjacent to the semiconductor substrate;

at least one nozzle, injecting chemical liquid on the semiconductor substrate and a gap between the semiconductor substrate and the ultra/mega sonic device;

an ultra/mega sonic power supply;

a host computer, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 to drive the ultra/mega sonic device, before bubble cavitation in the liquid damaging patterned structure on the semiconductor substrate, setting the ultra/mega sonic power supply at zero output, after temperature inside bubble cooling down to a set temperature, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 again;

a detection system, detecting amplitude of each waveform output by the ultra/mega sonic power supply, comparing detected amplitude of each waveform with a preset value, if the detected amplitude of any waveform is larger than the preset value, the detection system sends out an alarm signal to the host computer, and the host computer receives the alarm signal and shuts down the ultra/mega sonic power supply, wherein the preset value is larger than waveform amplitude at normal operation.

20. The apparatus of claim 19, wherein the detection system includes a voltage attenuation circuit, an amplitude detection circuit, a main controller, a communication circuit and a power circuit.

21. The apparatus of claim 20, wherein the voltage attenuation circuit reduces the amplitude value of the waveform output by the ultra/mega sonic power supply.

22. The apparatus of claim 20, wherein the amplitude detection circuit includes a reference voltage generating circuit and a comparison circuit, the reference voltage generating circuit converts digital inputs from the main controller to analog DC reference voltages V_{ref+} and V_{ref-}, the comparison circuit compares the attenuated amplitude V_{in} output from the voltage attenuation circuit with the reference voltages V_{ref+} and V_{ref-}, if the attenuated amplitude V_{in} exceeds the reference voltages V_{ref+} and V_{ref-}, the amplitude detection circuit sends out the alarm signal to the host computer.

23. The apparatus of claim 19, wherein the ultra/mega sonic device is further coupled with the nozzle and positioned adjacent to the semiconductor substrate, the energy of the ultra/mega sonic device is transmitted to the semiconductor substrate through the liquid column out of the nozzle.

24. An apparatus for cleaning semiconductor substrate using ultra/mega sonic device, comprising:

a cassette, holding at least one semiconductor substrate;

a tank, holding the cassette;

an ultra/mega sonic device, being attached to outside wall of the tank;

at least one inlet, for filling chemical liquid into the tank to immerse the semiconductor substrate;

an ultra/mega sonic power supply;

a host computer, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 to drive the ultra/mega sonic device, before bubble cavitation in the liquid damaging patterned structure on the semiconductor substrate, setting the ultra/mega sonic power supply at zero output, after temperature inside bubble cooling down to a set temperature, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 again;

a detection system, detecting power on time at power P1 and frequency f1 and power off time separately, comparing the detected power on time at power P1 and frequency f1 with a preset time τ_1, if the detected power on time is longer than the preset time τ_1, the detection system sends out an alarm signal to the host computer, and the host computer receives the alarm

signal and shuts down the ultra/mega sonic power supply, comparing the detected power off time with a preset time τ_2, if the detected power off time is shorter than the preset time τ_2, the detection system sends out an alarm signal to the host computer, and the host computer receives the alarm signal and shuts down the ultra/mega sonic power supply.

25. The apparatus of claim 24, wherein the detection system includes a voltage attenuation circuit, a shaping circuit, a main controller, a communication circuit and a power circuit.

26. An apparatus for cleaning semiconductor substrate using ultra/mega sonic device, comprising:

a cassette, holding at least one semiconductor substrate;

a tank, holding the cassette;

an ultra/mega sonic device, being attached to outside wall of the tank;

at least one inlet, for filling chemical liquid into the tank to immerse the semiconductor substrate;

an ultra/mega sonic power supply;

a host computer, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 to drive the ultra/mega sonic device, before bubble cavitation in the liquid damaging patterned structure on the semiconductor substrate, setting the ultra/mega sonic power supply at zero output, after temperature inside bubble cooling down to a set temperature, setting the ultra/mega sonic power supply at frequency f_1 and power P_1 again;

a detection system, detecting amplitude of each waveform output by the ultra/mega sonic power supply, comparing detected amplitude of each waveform with a preset value, if the detected amplitude of any waveform is larger than the preset value, the detection system sends out an alarm signal to the host computer, and the host computer receives the alarm signal and shuts down the ultra/mega sonic power supply, wherein the preset value is larger than waveform amplitude at normal operation.

27. The apparatus of claim 26, wherein the detection system includes a voltage attenuation circuit, an amplitude detection circuit, a main controller, a communication circuit and a power circuit.