

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 said ultra/mega sonic device;
- after micro jet generated by bubble implosion and before said micro jet generated by bubble implosion damaging patterned structure on the substrate, setting said ultra/mega sonic power supply at frequency f_2 and power P_2 to drive said ultra/mega sonic device;
- after temperature inside bubble cooling down to a set temperature, setting said ultra/mega sonic power supply at frequency f_1 and power P_1 again;
- repeating above steps till the substrate being cleaned.

2. The method of claim 1, wherein the bubble implosion is controlled under the implosion intensity that would result in the patterned structure damage by controlling the temperature T_n below the temperature T_d (controlling time of $\Delta\tau$), wherein T_n is the bubbles maximum temperature obtained by sonic power keeping working on the bubbles after the cycles of n , and T_d is the temperature of the accumulation of certain amount bubbles implosion with a high intensity (or power) to result in the patterned structure damage.

3. The method of claim 1, wherein said power value P_2 is set as zero.

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

- a chuck holding a substrate;
- an ultra/mega sonic device being positioned adjacent to the substrate;
- at least one nozzle injecting chemical liquid on the substrate and a gap between the substrate and the ultra/mega sonic device;
- an ultra/mega sonic power supply;
- a controller setting the ultra/mega sonic power supply at frequency f_1 and power P_1 to drive said ultra/mega sonic device; after micro jet generated by bubble implosion and before said micro jet generated by bubble implosion damaging patterned structure on the substrate, setting the ultra/mega sonic power supply at frequency f_2 and power P_2 to drive said

ultra/mega sonic device; 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; repeating above steps till the substrate being cleaned.

5. The apparatus of claim 4, wherein the bubble implosion is controlled under the implosion intensity that would result in the patterned structure damage by controlling the temperature T_n below the temperature T_d (controlling time of $\Delta\tau$), wherein T_n is the bubbles maximum temperature obtained by sonic power keeping working on the bubbles after the cycles of n , and T_d is the temperature of the accumulation of certain amount bubbles implosion with a high intensity (or power) to result in the patterned structure damage.

6. The apparatus of claim 4, wherein said power value P_2 is set as zero.

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

- a cassette holding at least one substrate;

- a tank holding said cassette;

- an ultra/mega sonic device being attached to outside wall of said tank;

- at least one inlet for filling chemical liquid into said tank to immerse said substrate;

- an ultra/mega sonic power supply;

- a controller setting the ultra/mega sonic power supply at frequency f_1 and power P_1 to drive said ultra/mega sonic device; after micro jet generated by bubble implosion and before said micro jet generated by bubble implosion damaging patterned structure on the substrate, setting said ultra/mega sonic power supply at frequency f_2 and power P_2 to drive said ultra/mega sonic device; after temperature inside bubble cooling down to a set temperature, setting said ultra/mega sonic power supply at frequency f_1 and power P_1 again; repeating above steps till the substrate being cleaned.

8. The apparatus of claim 7, wherein the bubble implosion is controlled under the implosion intensity that would result in the patterned structure damage by controlling the temperature T_n below the temperature T_d (controlling time of $\Delta\tau$), wherein T_n is the bubbles maximum temperature obtained by sonic power keeping working on the bubbles after the cycles of n , and T_d is the temperature of the accumulation of certain amount bubbles implosion with a high intensity (or power) to result in the patterned structure damage.

9. The apparatus of claim 7, wherein said power value P_2 is set as zero.

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

a chuck holding a substrate;

an ultra/mega sonic device coupled with a nozzle being positioned adjacent to the substrate, said nozzle injecting chemical liquid on the substrate;

an ultra/mega sonic power supply;

a controller setting the ultra/mega sonic power supply at frequency f_1 and power P_1 to drive said ultra/mega sonic device; after micro jet generated by bubble implosion and before said micro jet generated by bubble implosion damaging patterned structure on the substrate, setting said ultra/mega sonic power supply at frequency f_2 and power P_2 to drive said ultra/mega sonic device; after temperature inside bubble cooling down to a set temperature, setting said ultra/mega sonic power supply at frequency f_1 and power P_1 again; repeating above steps till the substrate being cleaned.

11. The apparatus of claim 10, wherein the bubble implosion is controlled under the implosion intensity that would result in the patterned structure damage by controlling the temperature T_n below the temperature T_d (controlling time of $\Delta\tau$), wherein T_n is the bubbles maximum temperature obtained by sonic power keeping working on the bubbles after the cycles of n , and T_d is the temperature of the accumulation of certain amount bubbles implosion with a high intensity (or power) to result in the patterned structure damage.

12. The apparatus of claim 10, wherein said power value P_2 is set as zero.