CLAIMS

1. A substrate cleaning method, comprising:

placing a substrate on a substrate holder;

delivering cleaning liquid onto the surface of the substrate;

implementing a pre-treatment process to detach bubbles from the surface of the substrate; and

implementing an ultra or mega sonic cleaning process for cleaning the substrate~~.~~ wherein the step of implementing a pre-treatment process to detach bubbles from the surface of the substrate comprises applying an ultra or mega sonic with a first power to the cleaning liquid to generate a stable bubble cavitation.

2. The method of claim 1, wherein the time duration of implementing the pre-treatment process is 5 sec. or more than 5 sec.

3. The method of claim 1, wherein the step of implementing a pre-treatment process to detach bubbles from the surface of the substrate comprises modifying the substrate surface from hydrophobic to hydrophilic.

4. The method of claim 3, wherein modifying the substrate surface from hydrophobic to hydrophilic is implemented by supplying liquid chemical solution forming a hydrophilic coating layer on the substrate surface.

5. The method of claim 3, wherein modifying the substrate surface from hydrophobic to hydrophilic is implemented by supplying liquid chemical solution oxidizing the hydrophobic substrate surface to hydrophilic oxide layer.

6. The method of claim 1, wherein the step of implementing a pre-treatment process to detach bubbles from the surface of the substrate comprises supplying liquid chemical solution on the substrate surface to increase the wettability of the liquid chemical solution on the substrate surface.

~~7. The method of claim 1, wherein the step of implementing a pre-treatment process to detach bubbles from the surface of the substrate comprises applying an ultra or mega sonic with a first power to the cleaning liquid to generate a stable bubble cavitation.~~

~~8~~7. The method of claim ~~7~~1, wherein the ultra or mega sonic runs on a continuous mode or pulse mode.

~~9~~8. The method of claim 1, wherein the step of implementing a pre-treatment process to detach bubbles from the surface of the substrate comprises removing impurities attached on the substrate surface.

~~10~~9. The method of claim ~~9~~8, wherein the impurities attached on the substrate surface is removed by using chemical solution.

~~11. The method of claim 10, further comprising applying an ultra or mega sonic with a first power to the chemical solution to generate a stable bubble cavitation.~~

~~12. The method of claim 11, wherein the ultra or mega sonic runs on a continuous mode or pulse mode.~~

~~13~~10. The method of claim 1, wherein the step of implementing a pre-treatment process to detach bubbles from the surface of the substrate comprises removing particles and then detaching bubbles from the surface of the substrate.

~~14. The method of claim 13, wherein an ultra or mega sonic with a first power is applied to the cleaning liquid to remove the particle and detach the bubbles from the surface of the substrate.~~

~~15. The method of claim 14, wherein the ultra or mega sonic runs on a continuous mode or pulse mode.~~

~~16~~11. The method of claim ~~13~~10, wherein supplying liquid chemical solution on the substrate surface to react or dissolve the particles.

~~17~~12. The method of claim 1, wherein the step of implementing an ultra or mega sonic cleaning process for cleaning the substrate comprises applying an ultra or mega sonic with a power to implement the ultra or mega sonic cleaning process for cleaning the substrate, the ultra or mega sonic runs on a continuous mode or pulse mode.

~~18~~13. A substrate cleaning apparatus, comprising:

a substrate holder configured to hold the substrate;

at least one inlet configured to deliver cleaning liquid onto the surface of the substrate;

an ultra or mega sonic device configured to deliver acoustic energy to the cleaning liquid;

one or more controllers configured to:

control the ultra or mega sonic device with a first power to implement a pre-treatment process to the cleaning liquid to detach bubbles from the surface of the substrate and to generate a stable bubble cavitation; and

control the ultra or mega sonic device with a second power higher than the first power to implement an ultra or mega sonic cleaning process for cleaning the substrate.

~~19~~14. The apparatus of claim ~~18~~13, wherein the ultra or mega sonic device runs on a continuous mode or pulse mode.

~~20~~15. The apparatus of claim ~~18~~13, wherein the inlet supplies liquid chemical solution to modify the substrate surface from hydrophobic to hydrophilic to detach bubbles from the surface of the substrate.

~~21~~16. The apparatus of claim ~~18~~13, wherein the inlet supplies liquid chemical solution on the substrate surface to increase the wettability of the liquid chemical solution on the substrate surface to detach bubbles from the surface of the substrate.

~~22~~17. The apparatus of claim ~~18~~13, wherein the inlet supplies liquid chemical solution to remove impurities attached on the substrate surface so as to detach bubbles from the surface of the substrate.

~~23~~18. The apparatus of claim ~~18~~13, wherein the inlet supplies liquid chemical solution ~~on~~ the substrate surface to react or dissolve particles so as to detach bubbles from the surface of the substrate.

~~24. A substrate cleaning apparatus, comprising:~~

~~a substrate holder configured to hold the substrate;~~

~~one or more inlets configured to deliver cleaning liquid onto the surface of the substrate for cleaning the substrate and to deliver liquid chemical solution onto the surface of the substrate for implementing a pre-treatment process to detach bubbles from the surface of the substrate;~~

~~an ultra or mega sonic device configured to deliver acoustic energy to the cleaning liquid for cleaning the substrate.~~

~~25. The apparatus of claim 24, wherein the time duration of implementing the pre-treatment process is 5 sec. or more than 5 sec.~~

~~26. The apparatus of claim 24, wherein the ultra or mega sonic device runs on a continuous mode or pulse mode.~~