~~What is claimed is:~~CLAIMS

1. An apparatus for cleaning flip chip assemblies, comprising:

a chuck assembly;

a motor coupled to the chuck assembly by a spindle;

at least one carrier for holding a flip chip;

at least one spray nozzle for directing DIW, a cleaning solution, a gas or a vapor~~.~~;

wherein the motor drives the chuck assembly to rotate at a rotation speed, the rotation speed changes between a low rotation speed and a high rotation speed alternatively during a cleaning process, wherein the low rotation speed is less than a threshold speed and the high rotation speed is higher than the threshold speed, the threshold speed is determined based on the size of a flip chip, the relative position of the flip chip, the spin time of the chuck, and the density and surface tension coefficient of a liquid flowed to the flip chip.

2. The apparatus of claim 1, wherein said flip chip carrier is located off rotation center on the chuck assembly.

3. The apparatus of claim 1, wherein the apparatus further comprises a loading plate, and said flip chip carrier is located on said loading plate, and said loading plate is held by said chuck assembly.

4. The apparatus of claim 1, wherein said carrier holds a flip chip in top fixing manner.

5. The apparatus of claim 1, wherein said carrier holds a flip chip in bottom fixing manner.

6. The apparatus of claim 1, wherein said flip chip carriers is located at the off rotation center on the chuck assembly, the distribution pattern of the flip chip carriers is circle, square, swirl or concentric.

7. The apparatus of claim 1, wherein said spray nozzles is a fix nozzle, a scan nozzle or a swing nozzle.

8. The apparatus of claim 1, wherein said spray nozzle is disposed at the top of the chuck assembly.

9. The apparatus of claim 1, wherein said spray nozzle is disposed at one side of the flip chip carriers.

10. The apparatus of claim 1 further comprising a recess located in the center of said chuck assembly, and a guide channel connects the recess with each flip chip carrier.

11. The apparatus of claim 1 further comprising a recess with a spray nozzle at edge for holding each carrier.

12. The apparatus of claim 1 further comprising an outer tank for holding cleaning solution for pre-soaking said flip chips held by said chuck assembly.

13. The apparatus of claim 12 further comprising an ultrasonic/megasonic device attached on wall of said outer tank.

14. The apparatus of claim 1, wherein said spindle is disposed at the bottom of the chuck assembly.

15. The apparatus of claim 1, wherein said spindle is disposed on the top of the chuck assembly.

16. The apparatus of claim 1 further comprising at least one ultrasonic/megasonic device.

17. The apparatus of claim ~~14~~16, wherein said ultrasonic/megasonic device operates in a range from 5KHz to 10MHz.

18. The apparatus of claim ~~14~~16, wherein said ultrasonic/megasonic device is disposed in a position above said carrier and said chuck assembly.

19. A method for cleaning flip chip assemblies comprising:

loading at least one flip chip to flip chip carriers held by a chuck assembly;

flowing a cleaning solution for removing contaminants;

rotating the chuck assembly at a rotation speed~~.~~;

wherein the rotation speed changes between a low rotation speed and a high rotation speed alternatively during a cleaning process, wherein the low rotation speed is less than a threshold speed and the high rotation speed is higher than the threshold speed, the threshold speed is determined based on the size of a flip chip, the relative position of the flip chip, the spin time of the chuck, and the density and surface tension coefficient of a liquid flowed to the flip chip.

20. The method of claim 19, further comprising the steps of:

changing chuck rotation speed during a cleaning process, in which a low rotation speed and a high rotation speed are used alternatively;

said low rotation speed N_l is in the range less than the threshold speed $\frac{60\times\left(\frac{2\sigma}{\rho hAr}+\frac{2B}{rt^2}\right)^{\frac{1}{2}}}{2\pi}$;

said high speed N_h is in the range higher than the threshold speed $\frac{60\times\left(\frac{2\sigma}{\rho hAr}+\frac{2B}{rt^2}\right)^{\frac{1}{2}}}{2\pi}$;

where B denotes length of the flip chip, A denotes width of the flip chip, r denotes radius of position of the flip chip carrier on the chuck, h denotes space between two chip bond pads, t denotes chuck spin time, ρ denotes liquid density, and σ denotes liquid surface tension coefficient.

21. The method of claim 19, further comprising the step of:

applying ultrasonic/megasonic energy to the flip chip during cleaning process.

22. The method of claim 19, further comprising the step of:

blowing a gas or a vapor via ~~the~~ spray nozzles for drying the flip chips.

23. A method for cleaning flip chip assemblies comprising:

loading at least one flip chip to flip chip carriers held by a loading plate;

placing the loading plate into a cassette;

transferring a loading plate from a cassette to a chuck assembly in the process chamber;

flowing a cleaning solution onto the flip chips for removing contaminants;

rotating the chuck assembly at a rotation speed;

wherein the rotation speed changes between a low rotation speed and a high rotation speed alternatively during a cleaning process, wherein the low rotation speed is less than a threshold speed and the high rotation speed is higher than the threshold

speed, the threshold speed is determined based on the size of a flip chip, the relative position of the flip chip, the spin time of the chuck, and the density and surface tension coefficient of a liquid flowed to the flip chip.

24. The method of claim 23, further comprising the steps of:

changing chuck rotation speed during a cleaning process, in which a low rotation speed and a high rotation speed are used alternatively;

said low rotation speed N_l is in the range less than the threshold speed $\frac{60\times\left(\frac{2\sigma}{\rho hAr}+\frac{2B}{rt^2}\right)^{\frac{1}{2}}}{2\pi}$;

said high speed N_h is in the range higher than the threshold speed $\frac{60\times\left(\frac{2\sigma}{\rho hAr}+\frac{2B}{rt^2}\right)^{\frac{1}{2}}}{2\pi}$;

where B denotes length of a flip chip, A denotes width of a flip chip, r denotes radius of position of the flip chip carrier on the chuck, h denotes space between the two chip bond pads, t denotes chuck spin time, ρ denotes liquid density, and σ denotes liquid surface tension coefficient.

25. The method of claim 23, further comprising the step of:

applying ultrasonic/megasonic energy to the flip chip during cleaning process.

26. The method of claim 23, further comprising the step of:

blowing a gas or a vapor via the spray nozzles for drying the flip chips.