Claims

1. A method for TSVs reveal, comprising:

providing a Si substrate having a plurality of TSVs formed inside the Si substrate;

rotating the Si substrate and spraying a first etchant onto the backside of the Si substrate to etch the backside of the Si substrate, and stopping etching before the TSVs being exposed to the backside of the Si substrate; and

rotating the Si substrate and spraying a second etchant onto the backside of the Si substrate to etch the backside of the Si substrate until the TSVs being exposed to the backside of the Si substrate, and reversing the rotation direction of the Si substrate at fixed intervals during spraying the second etchant onto the backside of the Si substrate.

2. The method of claim 1, wherein the first etchant is a strong acid substance having a low selectivity for Si and SiO_2.

3. The method of claim 2, wherein the strong acid substance is HN (HF/HNO_3) based solution.

4. The method of claim 1, wherein the second etchant is a strong alkaline substance having a high selectivity for Si and SiO_2.

5. The method of claim 4, wherein the strong alkaline substance is TMAH-, KOH- or EDP- based solution.

6. The method of claim 1, wherein reversing the rotation direction of the Si substrate at fixed intervals further comprises:

rotating the Si substrate along clockwise direction and counterclockwise direction alternatively at fixed intervals.

7. The method of claim 1, wherein the first etchant and the second etchant are respectively sprayed onto the backside of the Si substrate by a nozzle.

8. The method of claim 7, further comprising:

moving the nozzle horizontally from the center to outer edge of the backside of the Si substrate during the etching steps.

9. The method of claim 8, wherein the horizontal move speed of the nozzle at the center region of the backside of the Si substrate is higher than at the edge region of the backside of the Si substrate.

10. The method of claim 8, further comprising:

setting nozzle resting positions during the nozzle moving horizontally from the center to outer edge of the backside of the Si substrate.

11. The method of claim 7, further comprising:

moving the nozzle vertically to be close to or far away from the backside of the Si substrate.

12. The method of claim 11, wherein the moving distance between the nozzle and the backside of the Si substrate is between 0.5cm to 10cm.

13. The method of claim 7, further comprising:

changing spraying angle of the nozzle along with the nozzle being located at different region of the backside of the Si substrate during spraying the second etchant

onto the backside of the Si substrate to etch the backside of the Si substrate until the TSVs are exposed to the backside of the Si substrate.

14. The method of claim 7, wherein rotating the Si substrate and spraying a second etchant onto the backside of the Si substrate further comprises:

moving the nozzle above the outer edge of the backside of the Si substrate and rotating the Si substrate at a speed which is higher than the rotation speed of the Si substrate when the nozzle is above the center region of the backside of the Si substrate, so that the second etchant achieves a synchronous speed with the Si substrate.

15. The method of claim 1, further comprising:

supplying a protecting gas or protecting liquid onto the frontside of the Si substrate to protect the frontside of the Si substrate from etching during the etching steps.

16. The method of claim 1, further comprising:

supplying DIW onto the backside of the Si substrate for pre wetting the backside of the Si substrate before spraying the first etchant onto the backside of the Si substrate.

17. The method of claim 1, further comprising:

supplying DIW onto the backside of the Si substrate for post rinsing the backside of the Si substrate after spraying the second etchant onto the backside of the Si substrate.

18. The method of claim 17, further comprising:

rotating the Si substrate at a predefined high speed and supplying a gas or a vapor for drying the Si substrate after spraying DIW onto the backside of the Si substrate for post rinsing.

19. The method of claim 1, further comprising:

measuring steps which comprising measuring the Si substrate thickness before spraying the first etchant onto the backside of the Si substrate, after etching by using the first etchant, and after etching by using the second etchant.

20. An apparatus for TSVs reveal, comprising:

a rotatable chuck assembly capable of reversing the rotation direction at fixed intervals, the chuck assembly holding and positioning a Si substrate having a plurality of TSVs formed inside the Si substrate; and

at least one nozzle disposed above the chuck assembly, the at least one nozzle arranged to spray a first etchant onto the backside of the Si substrate to etch the backside of the Si substrate, and to stop spraying the first etchant before the TSVs are exposed to the backside of the Si substrate, the at least one nozzle further arranged to spray a second etchant onto the backside of the Si substrate to etch the backside of the Si substrate until the TSVs are exposed to the backside of the Si substrate;

wherein the chuck assembly is arranged to rotate clockwise and counterclockwise alternately at fixed intervals when the at least one nozzle sprays the second etchant onto the backside of the Si substrate to etch the backside of the Si substrate until the TSVs are exposed to the backside of the Si substrate.

21. The apparatus of claim 20, wherein the chuck assembly defines a plurality of through holes through where a protecting gas or protecting liquid is supplied onto the frontside of the Si substrate.

22. The apparatus of claim 20, wherein the at least one nozzle scans or swings horizontally from the center to outer edge of the backside of the Si substrate.

23. The apparatus of claim 22, wherein the horizontal move speed and acceleration of the nozzle is adjustable.

24. The apparatus of claim 22, further comprising nozzle resting positions being set during the nozzle scanning or swinging horizontally from the center to outer edge of the backside of the Si substrate.

25. The apparatus of claim 20, wherein the nozzle moves vertically to be close to or far away from the backside of the Si substrate.

26. The apparatus of claim 25, wherein the moving distance between the nozzle and the backside of the Si substrate is between 0.5cm to 10cm.

27. The apparatus of claim 20, wherein the spraying angle of the nozzle is changable along with the nozzle being located at different region of the backside of the Si substrate when the at least one nozzle sprays the second etchant onto the backside of the Si substrate to etch the backside of the Si substrate until the TSVs are exposed to the backside of the Si substrate.

28. The apparatus of claim 20, wherein the at least one nozzle moves above the outer edge of the backside of the Si substrate and the chuck assembly rotates at a speed which is higher than the rotation speed of the chuck assembly when the nozzle is above the center region of the backside of the Si substrate, so that the second etchant achieves a synchronous speed with the Si substrate.

29. The apparatus of claim 21, further comprising a protecting ring disposed on the chuck assembly for shaping the airflow of the protecting gas.

30. The apparatus of claim 29, wherein the protecting ring is detachable from the chuck assembly.

31. The apparatus of claim 29, wherein the inner wall of the protecting ring is a vertical plane or an irregular plane.

32. The apparatus of claim 29, wherein the protecting ring is jointed on the chuck assembly or separated from the chuck assembly to form a gap therebetween.

33. The apparatus of claim 20, further comprising a plurality of locating pins uniformly disposed at the chuck assembly for holding and positioning the Si substrate.