CLAIMS:

1. A method for cleaning a substrate comprising features of patterned structures, the method comprising:

placing the substrate on a substrate holder configured to rotate the substrate;

applying cleaning liquid on the substrate;

rotating the substrate by the substrate holder at a first rate when acoustic energy is being applied to the cleaning liquid by a transducer; and

rotating the substrate by the substrate holder at a second rate higher than the first rate when acoustic energy is not being applied to the cleaning liquid by the transducer;

wherein the method further comprises performing pretreatment on the substrate to remove defects that attract bubbles before applying the cleaning liquid on the substrate.

2. The method of claim 1, wherein the steps of rotating the substrate at a first rate when acoustic energy is being applied and rotating the substrate at a second rate when acoustic energy is not being applied are alternately applied one after another for a number of cycles.

3. The method of claim 1, wherein the first rate is from 10 revolutions per minute to 200 revolutions per minute.

4. The method of claim 1, wherein the second rate is from 100 revolutions per minute to 1500 revolutions per minute.

5. The method of claim 1, wherein rotating the substrate at a first rate when acoustic energy is being applied comprises:

controlling, based on a timer, a power supply of the transducer to deliver acoustic energy to the cleaning liquid at a first frequency and a first power level for a predetermined first time period; and

controlling, based on the timer, the power supply of the transducer to deliver acoustic energy to the cleaning liquid at a second frequency and a second power level for a predetermined second time period.

6. The method of claim 5, wherein the first and second time periods, the first and second power levels, and the first and second frequencies are determined such that a percentage of damaged features as a result of delivering the acoustic energy is lower than a predetermined threshold.

7. The method of claim 1, wherein a device manufacturing node of the substrate is 45 nanometers or smaller than 45 nanometers.

8. The method of claim 1, wherein a line width of the features of patterned structures is 60 nanometers or smaller than 60 nanometers.

9. The method of claim 1, wherein a depth to width aspect ratio of the features of patterned structures is 3 or larger than 3.

10. The method of claim 1, further comprising moving the transducer away from the cleaning liquid after rotating the substrate at a first rate when acoustic energy is being applied and before rotating the substrate at a second rate when acoustic energy is not being applied.

11. The method of claim 1, further comprising performing pretreatment on the cleaning liquid to remove at least a part of bubbles within the cleaning liquid before applying cleaning liquid on the substrate.

12. A method for cleaning a substrate comprising features of patterned structures, the method comprising:

performing pretreatment on the substrate to remove defects that attract bubbles;

after the pretreatment step, applying cleaning liquid on the substrate;

controlling, based on a timer, a power supply of a transducer to deliver acoustic energy to the cleaning liquid at a first frequency and a first power level for a predetermined first time period; and

controlling, based on the timer, the power supply of the transducer to deliver acoustic energy to the cleaning liquid at a second frequency and a second power level for a predetermined second time period,

wherein the first and second time periods are alternately applied one after another for a predetermined number of cycles.

13. The method of claim 12, wherein the first and second time periods, the first and second power levels, and the first and second frequencies are determined such that a percentage of damaged features as a result of delivering the acoustic energy is lower than a predetermined threshold.

14. The method of claim 12, wherein the pretreatment comprises applying plasma energy on the substrate.

15. The method of claim 12, wherein the pretreatment comprises applying one or more pretreatment liquids on the substrate.

16. The method of claim 15, wherein applying one or more pretreatment liquids on the substrate comprises applying SC1 liquid.

17. The method of claim 15, wherein applying one or more pretreatment liquids on the substrate comprises:

applying ozone liquid on the substrate;

applying deionized water on the substrate; and

applying diluted hydrogen fluoride on the substrate.