CLAIMS

1. A method for cleaning a substrate, comprising:

performing a first application of a cleaning material to a surface of a substrate, wherein the cleaning material includes one or more viscoelastic materials for entrapping contaminants present on the surface of the substrate;

performing a first application of a rinsing fluid to the surface of the substrate so as to rinse the cleaning material from the surface of the substrate;

applying a controlled vacuum suction to the surface of the substrate so as to remove the cleaning material and a portion of the rinsing fluid from the surface of the substrate and so as to leave a residual thin film of the rinsing fluid on the surface of the substrate;

performing a second application of the cleaning material to the surface of the substrate~~, wherein the second application of the cleaning material is applied to the surface of the substrate having the residual thin film of rinsing fluid present thereon~~ by dispensing a vertical curtain of the cleaning material to directly and vertically impact the residual thin film of the rinsing fluid as left on the surface of the substrate, whereby the residual thin film of the ringing fluid accumulates upon encountering the vertical curtain of the cleaning material and moves from the surface of the substrate, wherein a higher viscosity of the cleaning material relative to the residual thin film of the rinsing fluid provides for the accumulation and movement of the residual thin film of the rinsing fluid from the surface of the substrate; and

performing a second application of the rinsing fluid to the surface of the substrate so as to rinse the cleaning material from the surface of the substrate.

2. A method for cleaning a substrate as recited in claim 1, wherein the cleaning material is defined as a polar solvent having polyacrylamide dissolved therein.

3. A method for cleaning a substrate as recited in claim 1, wherein the rinsing fluid is defined as deionized water.

4. A method for cleaning a substrate as recited in claim 1, wherein the rinsing fluid is defined as one or more of deionized water, dimethyl sulfoxide, dimethyl formamide, dimethyl acetate, a polar solvent, and an atomized polar solvent.

5. A method for cleaning a substrate as recited in claim 1, wherein the first application of the rinsing fluid is performed immediately following the first application of the cleaning material, and wherein the second application of the rinsing fluid is performed immediately following the second application of the cleaning material.

6. A method for cleaning a substrate as recited in claim 1, further comprising:

operating a first processing head to perform ~~both~~ the first application of the cleaning material ~~and~~, the first application of the rinsing fluid~~;~~, and apply the controlled vacuum suction;

operating a second processing head to perform both the second application of the cleaning material and the second application of the rinsing fluid; and

moving the substrate beneath the first and second processing heads in a successive manner.

7. A method for cleaning a substrate as recited in claim 6, ~~further comprising:~~

~~controlling a vacuum of~~wherein the ~~first processing head to leave a~~ controlled ~~thickness of~~ vacuum suction is applied such that the residual thin film of the rinsing fluid has a thickness on the surface of the substrate within a range extending from about 0.01 millimeter to about 5 millimeters.

8. A method for cleaning a substrate, comprising:

moving a substrate to be cleaned under a first processing head;

operating the first processing head to dispense a cleaning material over the substrate as the substrate is moved under the first processing head, wherein the cleaning material includes one or more viscoelastic materials for entrapping contaminants present on the substrate;

operating the first processing head to ~~rinse~~apply a rinsing fluid to the substrate following the dispensing of the cleaning material on the substrate;

operating the first processing head to apply a controlled vacuum suction to the substrate so as to remove the cleaning material and a portion of the rinsing fluid from the substrate and so as to leave a residual thin film of the rinsing fluid on the substrate as the substrate emerges from under the first processing head;

moving the substrate having the residual thin film of the rinsing fluid thereon under a second processing head;

operating the second processing head to dispense a vertical curtain of the cleaning material over the substrate ~~such that the cleaning material contacts~~to directly and vertically impact the residual thin film of the rinsing fluid present on the substrate, whereby the residual thin film of the rinsing fluid accumulates upon encountering the vertical curtain of the cleaning material and moves from the substrate, wherein a higher viscosity of the cleaning material relative to the residual thin film of the rinsing fluid provides for the accumulation and movement of the residual thin film of the rinsing fluid from the substrate; and

operating the second processing head to rinse the substrate following the dispensing of the cleaning material on the substrate by the second processing head.

9. A method for cleaning a substrate as recited in claim 8, wherein the cleaning material is a polar solvent having polyacrylamide dissolved therein, and wherein the rinsing fluid is deionized water.

10. A method for cleaning a substrate as recited in claim 8, wherein the rinsing fluid is defined as one or more of deionized water, dimethyl sulfoxide, dimethyl formamide, dimethyl acetate, a polar solvent, and an atomized polar solvent.

11. A method for cleaning a substrate as recited in claim 8, wherein each of the first and second processing heads is operated to dispense the cleaning material across the substrate along a dispense line extending perpendicular to a diametrical chord of the substrate, while the substrate is moved in a direction of the diametrical chord.

12. A method for cleaning a substrate as recited in claim 8, wherein a top surface of the substrate is maintained in a substantially horizontal orientation as the substrate is

moved under the first and second processing heads, and wherein the first and second processing heads are maintained in sufficiently close proximity to the top surface of the substrate so as to respectively establish controlled meniscuses of the rinsing fluid between the first and second processing heads and the top surface of the substrate.

13. A method for cleaning a substrate as recited in claim 8, ~~further comprising: controlling a~~ wherein the controlled vacuum suction of the first processing head ~~to leave a controlled thickness of~~ is applied such that the residual thin film of the rinsing fluid has a thickness on the substrate within a range extending from about 0.01 millimeter to about 5 millimeters.

14. A method for cleaning a substrate as recited in claim 8, further comprising:

moving the substrate under a third processing head; and operating the third processing head to dry the substrate.

~~15. An apparatus for cleaning a substrate, comprising: a substrate carrier defined to move a substrate in a substantially linear path while maintaining the substrate in a substantially horizontal orientation; a first processing head positioned over the path of the substrate such that the first processing head is defined to dispense a cleaning material over the substrate, and dispense a rinsing fluid on the substrate, and remove the rinsing fluid and cleaning material from the substrate so as to leave a residual thin film of the rinsing fluid on the substrate; and a second processing head positioned over the path of the substrate behind the first processing head relative to a direction of travel of the substrate carrier, the second processing head defined to dispense the cleaning material over the substrate such that the cleaning material is made to contact the residual thin film of rinsing fluid present on the substrate, and dispense a rinsing fluid on the substrate, and remove the rinsing fluid and cleaning material from the substrate, wherein the cleaning material includes one or more viscoelastic materials for entrapping contaminants present on the substrate.~~

~~16. An apparatus for cleaning a substrate as recited in claim 15, wherein each of the first and second processing heads is positioned to dispense the cleaning material across~~

~~the substrate along a dispense line extending perpendicular to linear path along which the substrate carrier is defined to move the substrate.~~

~~17. An apparatus for cleaning a substrate as recited in claim 15, wherein the linear path of the substrate carrier is defined such that a top surface of the substrate is substantially horizontal and parallel to an underside of each of the first and second processing heads, and wherein the first and second processing heads are positioned in sufficiently close proximity to the linear path of the substrate carrier such that a controlled meniscuses of the rinsing fluid is respectively established between each of the first and second processing heads and the top surface of the substrate.~~

~~18. An apparatus for cleaning a substrate as recited in claim 15, wherein the first processing head includes a controllable vacuum for removing the rinsing fluid and cleaning material from the substrate, wherein the controllable vacuum is defined to enable control of a thickness of the residual thin film of the rinsing fluid to be left on the substrate by the first processing head.~~

~~19. An apparatus for cleaning a substrate as recited in claim 15, wherein the cleaning material is defined as a polar solvent having polyacrylamide dissolved therein, and wherein the rinsing fluid is deionized water.~~

~~20. An apparatus for cleaning a substrate as recited in claim 15, further comprising: a third processing head positioned over the path of the substrate behind the second processing head relative to a direction of travel of the substrate carrier, the third processing head defined to dry the substrate.~~