Claims

~~[Claim 0001.]~~ A method for treating a surface of a semiconductor wafer ~~an article~~ with an oxidizing fluid wherein said surface to be treated comprises photoresist that includes ions implanted during a previous processing stage, the method comprising

dispensing an oxidizing fluid onto a surface of a semiconductor wafer ~~an article~~ to be treated, wherein said oxidizing fluid is a mixture of an inorganic acid and an oxidizing gas, said oxidizing fluid having the form of a dispersed phase of bubbles of said oxidizing gas in a continuous phase of said inorganic acid, wherein the dispersed phase constitutes at least 10 vol.% of said oxidizing fluid,

wherein the semiconductor wafer is positioned on a spin chuck in a single wafer wet processing station, and

wherein the fluid is dispensed onto the surface in a flow at a velocity in a range of 0.1m/s to 10m/s from at least one nozzle orifice with a cross-sectional area in the range of 3 to 300 mm^2.

~~[Claim 0002] The method according to claim 1, wherein said article is a semiconductor wafer, and wherein said surface to be treated comprises photoresist that includes ions implanted during a previous processing stage.~~

~~[Claim 0003] The method according to claim 2, wherein the semiconductor wafer is positioned on a spin chuck in a single wafer wet processing station.~~

~~[Claim 0004] The method according to claim 1, wherein the fluid is dispensed onto the surface in a flow at a velocity in a range of 0.1m/s to 10m/s from at least one nozzle orifice with a cross-sectional area in the range of 3 to 300 mm².~~

~~[Claim 0005]~~2. The method according to claim 1, wherein the inorganic acid is an aqueous solution of an inorganic acid at a concentration of at least 80 mass% or a pure acid.

~~[Claim 0006]~~3. The method according to claim ~~5~~2, wherein the inorganic acid is an aqueous solution of sulphuric acid at a concentration of at least 90 mass% or pure sulphuric acid (oleum).

~~[Claim 0007]~~4. The method according to claim 1, wherein the oxidizing gas contains ozone at a concentration of at least 100ppm.

~~[Claim 0008]~~5. The method according to claim ~~7~~4, wherein the oxidizing gas comprises ozone at a concentration in a range of about 1-20 mass% and oxygen at a concentration in a range of about 80-98 mass%.

~~[Claim 0009]~~6. The method according to claim 1, further comprising heating the inorganic acid to a temperature TL in a range of 100°C to 220°C before mixing with the oxidizing gas.

~~[Claim 0010]~~7. The method according to claim ~~9~~6,

wherein said temperature TL is in a range of 150°C to 180°C.

~~[Claim 0011]~~8. An apparatus for treating a surface of a semiconductor wafer ~~an article~~ with an oxidizing fluid, wherein said apparatus is a single wafer wet processing station comprising a spin chuck adapted to hold a semiconductor wafer comprising:

a dispenser comprising a dispense arm with a dispense nozzle for dispensing the fluid onto the wafer in a free flow, wherein the nozzle has an orifice having a cross-sectional area in the range of 3 to 300 mm^2;

a mixing junction communicating with infeed conduits of inorganic acid and oxidizing gas, said mixing junction being adapted to generate said oxidizing fluid in the form of a gas/liquid dispersion and supply said oxidizing fluid via a downstream conduit to said dispense nozzle;

wherein said mixing junction is positioned not more than 2m of conduit length from said dispense nozzle, such that the oxidizing fluid remains a gas/liquid dispersion upon exiting said orifice.

~~[Claim 0012]~~9. The apparatus according to claim ~~11~~8, wherein ~~said apparatus is a single wafer wet processing station comprising a spin chuck adapted to hold a semiconductor wafer, and~~ said nozzle is positioned relative to said spin chuck so as to dispense said oxidizing fluid downwardly onto an upwardly facing surface of the semiconductor wafer in a free flow.

~~[Claim 0013]~~10. The apparatus according to claim

~~11~~8, further comprising a heater for heating the inorganic acid upstream of said mixing junction to a temperature in a range of 100°C to 220°C.

~~[Claim 0014]~~11. The apparatus according to claim ~~11~~8, further comprising a flow controller comprising a flow meter positioned upstream of said mixing junction and adapted to measure a flow rate of the inorganic acid in an associated conduit before it is mixed with the oxidizing gas.

~~[Claim 0015]~~12. The apparatus according to claim ~~11~~8, wherein said nozzle orifice, said mixing junction and said infeed conduits of inorganic acid and oxidizing gas are dimensioned and positioned relative to one another so as to produce an oxidizing fluid at said nozzle orifice having a dispersed phase of bubbles of said oxidizing gas in a continuous phase of said inorganic acid, wherein the dispersed phase constitutes at least 10 vol.% of said oxidizing fluid.