Claims

1. A method comprising:

forming an SRP layer, wherein the SRP layer is a layer comprising a stimulus responsive polymer (SRP), the SRP characterized by a ceiling temperature (T_c) at which the SRP is in thermal equilibrium with its monomers, the T_c being between -80°C and 400°C, on a sensitive surface of a substrate; forming one or more cap layers on the SRP layer, wherein the one or more cap layers comprise a polymer layer; and further comprising removing the one or more cap layers prior to further processing of the semiconductor substrate.

2. The method of claim 1, further comprising exposing the substrate including the SRP layer and one or more cap layers to ambient conditions for a predetermined period.

3. The method of claim 2, further comprising removing the SRP layer.

4. The method of claim 3, wherein the one or more cap layers are removed prior to completing removal of the SRP layer.

5. The method of any of claims 1–4, wherein forming the one or more cap layers comprises maintaining the substrate temperature at no more than the ceiling temperature of the SRP.

6. The method of any of claims 2–5, wherein the one or more cap layers are removed by peeling.

7. The method of any of claims 2–5, wherein the one or more cap layers are removed by exposure to a solvent or plasma.

8. The method of claim 7, wherein the solvent is removed or the plasma is extinguished while the SRP layer is covering the sensitive surface.

9. The method of claims 2–5, wherein removing the one or more cap layers comprises depolymerizing the SRP and lifting off the one or more cap layers from the substrate.

10. The method of any of claims 1–9, wherein the SRP comprises a poly(phthalaldehyde), a poly(aldehyde), a poly(benzyl carbamate), a poly(benzyl ether), a poly(alpha-methyl styrene), a poly(carbonate), a poly(norbornene), a poly(olefin sulfone), a poly(glyoxylate), a poly(ester), or a poly(methyl methacrylate), as well as derivatives thereof, as a homopolymer or a constituent polymer of a co-polymer.

11. The method of any of claims 1-10, wherein one of the one or more cap layers is polytetrafluoroethylene, polyethylene polyacrylates, polystyrene, polyimides, polyamides, polyesters, polyurea, polyaldehydes, and polyurethanes.

12. The method of any of claims 1–10, wherein the SRP and the one or more cap layers are deposited by vapor deposition.

13. The method of claim 1, wherein the SRP comprises a poly(phthalaldehyde) or a poly(aldehyde) as a homopolymer or a constituent polymer of a co-polymer.

14. A formulation comprising:

a stimulus responsive polymer (SRP) characterized by a ceiling temperature (T_c) at which the SRP is in thermal equilibrium with its monomers, the T_c being between -80°C and 400°C and wherein the SRP comprises a poly(phthalaldehyde) as a homopolymer or a constituent polymer of a co-polymer; and

an organic acid having a pKa ≥ 1, wherein the SRP:organic acid wt% is at least 1:1.

15. The formulation of claim 14, wherein the T_c is less than 200°C.

16. The formulation of claim 14, wherein the T_c is greater than 150°C.

17. The formulation of any of claims 14-16, wherein the SRP and organic acid are in a solution, the solution comprising a solvent, the SRP, and the organic acid, wherein the wt% of the SRP in the solution is between 1% and 20%.

18. The formulation of claim 17, where the solvent is selected from diglyme, tetrahydrofuran, N-methyl-pyrrolidone, dimethylformamide, propylene carbonate, cyclopentanone, anisole, dichlorobenzene, propylene glycol methyl ether acetate, and 2-ethoxyethyl acetate.

19. The formulation of any of claims 14-18 wherein the organic acid is a linear alkyl carboxylic acid $C_XH_{2X}O_2$, where X is an integer, a corresponding dicarboxylic acid variant, or a derivative thereof.

20. The formulation of any of claims 14-18, wherein the organic acid is one of methanoic acid, acetic acid, oxalic acid, tartaric acid, ethanedioic acid, propanedioic acid, oxoethanoic acid, 2-hydroxyethanoic acid, prop-2-enoic acid, 2-propynoic acid, 2-hydroxypropanedioic acid, oxopropanedioic acid, 2,2-dihydroxypropanedioic acid, 2-oxopropanoic acid, 2-hydroxypropanoic acid, 3-hydroxypropanoic acid, and 2,3-dihydroxypropanoic acid.

21. A method comprising:

forming an SRP layer on a semiconductor substrate surface, wherein the SRP layer is a layer comprising a stimulus responsive polymer (SRP), the SRP characterized by a ceiling temperature (T_c) at which the SRP is in thermal equilibrium with its monomers, the T_c being between -80°C and 400°C and an organic acid having a pKa ≥ 1, wherein the SRP:organic acid wt% is at least 1:1.

22. A method comprising:

forming an SRP layer wherein the SRP layer is a layer comprising a stimulus responsive polymer (SRP), the SRP characterized by a ceiling temperature (T_c) at which the SRP is in thermal equilibrium with its monomers, the T_c being between -80°C and 400°C, on a sensitive surface of a substrate, the sensitive surface being metal; forming one or more cap layers on the SRP layer, wherein the SRP layer and the one or more cap layers are configured to protect sensitive surface from environmental effects during queue-time in a fabrication facility.

23. The method of claim 22, wherein the one or more cap layers are inorganic layers.

24. The method of any of claims 22 or 23, wherein the one or more cap layers include one or more of: SiO_x, SnO_x, AlO_x, TiO_x, ZrO_x, HfO_x, and ZnO_x, and nitride films such as SiN_x wherein x is a number greater than 0.