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; and forming one or more cap layers on the SRP layer.

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 one or more cap layers and 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 1–5, wherein the one or more cap layers are inorganic layers.

7. The method of any of claims 1–6, 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.

8. The method of any of claims 1–5, wherein the one or more cap layers include one or more polymer layers.

9. The method of any of claims 2–8, wherein the one or more cap layers are removed by peeling.

10. The method of any of claims 2–8, wherein the one or more cap layers are removed by exposure to a solvent or plasma.

11. The method of claim 10, wherein the solvent is removed or the plasma is extinguished while the SRP layer is covering the sensitive surface.

12. The method of claims 2–8, wherein removing the one or more cap layers comprises depolymerizing the SRP and lifting off the one or more cap layers from the substrate.

13. The method of any of claims 1–12, 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.

14. The method of any of claims 1–5 or 8–13, wherein one of the one or more cap layers is polytetrafluoroethylene, polyethylene polyacrylates, polystyrene, polyimides, polyamides, polyesters, polyurea, polyaldehydes, and polyurethanes.

15. The method of any of claims 1–13, wherein the SRP and the one or more cap layers are deposited by vapor deposition.

16. 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

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

17. The formulation of claim 16, 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.

18. The formulation of claim 16 or 17, wherein the T_c is less than 200°C.

19. The formulation of claim 16 or 17, wherein the T_c is greater than 150°C.

20. The formulation of any of claims 16–19, 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%.

21. The formulation of claim 20, 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.

22. The formulation of any of claims 16–21 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.

23. The formulation of any of claims 16–21, 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.

24. A processing tool comprising

one or more semiconductor processing chambers connected under vacuum, wherein the one or more semiconductor processing chamber are configured for forming an SRP layer, wherein the SRP layer is a layer comprising a stimulus responsive polymer (SRP), the SRP characterized by a ceiling temperature (Tc) at which the SRP is in thermal equilibrium with its monomers, the Tc being between -80°C and 400°C, on a sensitive surface of a substrate; and forming one or more cap layers on the SRP layer.

25. A processing tool comprising

a semiconductor processing chamber;

a gas inlet to the semiconductor processing chamber for delivering a formulation according to claim 16 to the processing chamber to form a SRP layer on a substrate in the processing chamber.