## CLAIMS

~~What is claimed is~~:

1. A polishing pad for polishing a substrate, the polishing pad comprising:

a foundation layer having a global top surface and a transparent region;

a polishing surface layer attached to the global top surface of the foundation layer, the polishing surface layer having a polishing surface and a back surface; and

an aperture disposed in the polishing pad from the back surface through to the polishing surface of the polishing surface layer and aligned with the transparent region of the foundation layer, wherein the foundation layer provides an impermeable seal for the aperture at the back surface of the polishing surface layer, wherein the aperture is disposed over a trench formed in but not through the transparent region of the foundation layer, and wherein the trench comprises a slurry deflection feature.

2. The polishing pad of claim 1, wherein the entire foundation layer is transparent.

~~3. The polishing pad of claim 1, wherein the aperture is disposed over the global top surface of the foundation layer.~~

~~4. The polishing pad of claim 1, wherein the aperture is disposed over an opening formed in the transparent region of the foundation layer, the bottom of the opening below the global top surface of the foundation layer.~~

~~5. The polishing pad of claim 4, wherein the opening formed in the foundation layer is a slurry deflection feature.~~

~~6. The polishing pad of claim 1, wherein the aperture is disposed over a protrusion formed from the transparent region of the foundation layer, the top of the protrusion above the global top surface of the foundation layer and located within the aperture.~~

3~~7~~. The polishing pad of claim 1, wherein the foundation layer has a first hardness, and the polishing surface layer has a second hardness different from the first hardness.

4~~8~~. The polishing pad of claim 1, wherein the polishing surface layer is bonded directly to the foundation layer.

59. The polishing pad of claim 73, wherein the polishing surface layer is covalently bonded to the foundation layer.

610. The polishing pad of claim 1, wherein the polishing surface layer comprises a continuous layer portion with a plurality of polishing features protruding there from, the continuous layer portion attached to the foundation layer.

711. The polishing pad of claim 1, wherein the polishing surface layer comprises a plurality of discrete polishing protrusions attached to the foundation layer.

812. The polishing pad of claim 1, wherein the foundation layer and the polishing surface layer have a peel resistance sufficient to withstand a shear force applied during the useful lifetime of the polishing pad.

913. The polishing pad of claim 1, wherein the foundation layer has a smooth surface with a surface roughness less than approximately 1 micrometer Ra (root mean square) where the polishing surface layer is attached to the foundation layer.

1014. The polishing pad of claim 1, wherein the foundation layer has a surface roughness greater than approximately 1 micrometer Ra (root mean square) where the polishing surface layer is attached to the foundation layer.

1115. The polishing pad of claim 1410, wherein the surface roughness is approximately in the range of 5 – 10 micrometers Ra (root mean square).

1216. The polishing pad of claim 1, wherein the polishing surface layer comprises a polyurethane material and the foundation layer comprises a polycarbonate material or a polyethylene terephthalate (PET) material.

1317. The polishing pad of claim 1, wherein the foundation layer has an energy loss factor of less than approximately 100 KEL at 1/Pa at 40°C, a compressibility of less than approximately 1 % under an applied pressure of 34kPa (5 PSI), a hardness greater than

approximately 75 Shore D, and comprises a polycarbonate material or a polyethylene terephthalate (PET) material.

1418. The polishing pad of claim 1, wherein the polishing surface layer has an energy loss factor of greater than approximately 1000 KEL at 1/Pa at 40°C, a compressibility of greater than approximately 0.1 % under an applied pressure of 34kPa (5 PSI), a hardness less than approximately 70 Shore D, and comprises a thermoset polyurethane material.

1519. The polishing pad of claim 1, wherein the polishing surface layer is a homogeneous polishing surface layer and has a pore density of closed cell pores approximately in the range of 6% - 50% total void volume.

1620. The polishing pad of claim 1, wherein the polishing surface layer has a first modulus of elasticity, and the foundation layer has a second modulus of elasticity greater than approximately 5 times the first modulus of elasticity.

1721. The polishing pad of claim 1, wherein the polishing surface layer has a thickness approximately in the range of 50-1300 micrometers (2 – 50 mils), and the foundation layer has a thickness of greater than approximately 500 micrometers (20 mils).

1822. The polishing pad of claim 2117, wherein the polishing surface layer has a thickness approximately in the range of 250-760 micrometers (10 – 30 mils) and a groove depth approximately in the range of 50-100% of the thickness of the polishing surface layer, and the foundation layer has a thickness approximately in the range of 1000-2000 micrometers (40 – 80 mils).

1923. The polishing pad of claim 1, wherein the foundation layer has a thickness and hardness relative to the thickness and hardness of the polishing surface layer sufficient to dictate the bulk polishing characteristics of the polishing pad.

2024. The polishing pad of claim 1, wherein the foundation layer is sufficiently thick for the polishing pad to provide die-level polishing planarity, but sufficiently thin for the polishing pad to provide wafer-level polishing uniformity.

2125. The polishing pad of claim 1, wherein the foundation layer comprises a stack of sub layers.

2226. The polishing pad of claim 1, wherein the transparent region of the foundation layer is substantially transparent to light selected from the group consisting of visible light, ultra-violet light, infra-red light, and a combination thereof.

2327. The polishing pad of claim 2622, wherein the transparent region of the foundation layer transmits approximately 80% or more of incident light in the 350-750 nanometer range.

2428. The polishing pad of claim 1, wherein the transparent region of the foundation layer is effectively transparent for transmission of light for end-point detection.

2529. The polishing pad of claim 1, wherein the transparent region of the foundation layer is nonporous.

2630. The polishing pad of claim 1, wherein the foundation layer extends beyond the polishing surface layer.

2731. The polishing pad of claim 1, wherein the polishing surface layer extends beyond the foundation layer.

2832. The polishing pad of claim 1, further comprising:

a sub pad having an aperture, wherein the foundation layer is disposed proximate to the sub pad, and wherein the aperture of the sub pad is aligned with the transparent region of the foundation layer.

2933. A polishing pad for polishing a substrate, the polishing pad comprising:

a foundation layer having a global top surface and a transparent region;

a polishing surface layer attached to the global top surface of the foundation layer, the polishing surface layer having a polishing surface and a back surface; and

an opening disposed in the polishing pad from the polishing surface, but not through to the back surface, of the polishing surface layer, the opening aligned with the transparent region of the foundation layer, wherein the opening is a slurry deflection feature.

3034. The polishing pad of claim 3329, wherein the entire foundation layer is transparent.

~~35. The polishing pad of claim 33, wherein the opening is disposed over the global top surface of the foundation layer.~~

~~36. The polishing pad of claim 33, wherein the opening is disposed over an opening formed in the transparent region of the foundation layer, and wherein the bottom of the opening of the foundation layer is below the global top surface of the foundation layer.~~

~~37. The polishing pad of claim 33, wherein the opening is disposed over a protrusion formed from the transparent region of the foundation layer, the top of the protrusion above the global top surface of the foundation layer.~~

~~38. The polishing pad of claim 33, wherein the opening is a slurry deflection feature.~~

3139. The polishing pad of claim 3329, wherein the foundation layer has a first hardness, and the polishing surface layer has a second hardness different from the first hardness.

3240. The polishing pad of claim 3329, wherein the polishing surface layer is bonded directly to the foundation layer.

3341. The polishing pad of claim 4032, wherein the polishing surface layer is covalently bonded to the foundation layer.

3442. The polishing pad of claim 3329, wherein the polishing surface layer comprises a continuous layer portion with a plurality of polishing features protruding there from, the continuous layer portion attached to the foundation layer.

3543. The polishing pad of claim 3329, wherein the polishing surface layer comprises a plurality of discrete polishing protrusions attached to the foundation layer.

3644. The polishing pad of claim 3329, wherein the foundation layer and the polishing surface layer have a peel resistance sufficient to withstand a shear force applied during the useful lifetime of the polishing pad.

3745. The polishing pad of claim 3329, wherein the foundation layer has a smooth surface with a surface roughness less than approximately 1 micrometer Ra (root mean square) where the polishing surface layer is attached to the foundation layer.

3846. The polishing pad of claim 3329, wherein the foundation layer has a surface roughness greater than approximately 1 micrometer Ra (root mean square) where the polishing surface layer is attached to the foundation layer.

3947. The polishing pad of claim 4638, wherein the surface roughness is approximately in the range of 5 – 10 micrometers Ra (root mean square).

4048. The polishing pad of claim 3329, wherein the polishing surface layer comprises a polyurethane material and the foundation layer comprises a polycarbonate material or a polyethylene terephthalate (PET) material.

4149. The polishing pad of claim 3329, wherein the foundation layer has an energy loss factor of less than approximately 100 KEL at 1/Pa at 40°C, a compressibility of less than approximately 1 % under an applied pressure of 34 kPa (5 PSI), a hardness greater than approximately 75 Shore D, and comprises a polycarbonate material.

4250. The polishing pad of claim 3329, wherein the polishing surface layer has an energy loss factor of greater than approximately 1000 KEL at 1/Pa at 40°C, a compressibility of greater than approximately 0.1 % under an applied pressure of 34 kPa (5 PSI), a hardness less than approximately 70 Shore D, and comprises a thermoset polyurethane material.

4351. The polishing pad of claim 3329, wherein the polishing surface layer is a homogeneous polishing surface layer and has a pore density of closed cell pores approximately in the range of 6% - 50% total void volume.

4452. The polishing pad of claim 3329, wherein the polishing surface layer has a first modulus of elasticity, and the foundation layer has a second modulus of elasticity greater than approximately 5 times the first modulus of elasticity.

4553. The polishing pad of claim 3329, wherein the polishing surface layer has a thickness approximately in the range of 50-1300 micrometers (2 – 50 mils), and the foundation layer has a thickness of greater than approximately 500 micrometers (20 mils).

4654. The polishing pad of claim 5345, wherein the polishing surface layer has a thickness approximately in the range of 250-760 micrometers (10 – 30 mils) and a groove depth approximately in the range of 50-100% of the thickness of the polishing surface layer, and the foundation layer has a thickness approximately in the range of 1000-2000 micrometers (40 – 80 mils).

4755. The polishing pad of claim 3329, wherein the foundation layer has a thickness and hardness relative to the thickness and hardness of the polishing surface layer sufficient to dictate the bulk polishing characteristics of the polishing pad.

4856. The polishing pad of claim 3329, wherein the foundation layer is sufficiently thick for the polishing pad to provide die-level polishing planarity, but sufficiently thin for the polishing pad to provide wafer-level polishing uniformity.

4957. The polishing pad of claim 3329, wherein the foundation layer comprises a stack of sub layers.

5058. The polishing pad of claim 3329, wherein the combination of the transparent region of the foundation layer and the portion of the back surface of the polishing surface layer

underneath the opening is substantially transparent to light selected from the group consisting of visible light, ultra-violet light, infra-red light, and a combination thereof.

5159. The polishing pad of claim ~~58~~50, wherein the combination of the transparent region of the foundation layer and the portion of the back surface of the polishing surface layer underneath the opening transmits approximately 80% or more of incident light in the 350-750 nanometer range.

5260. The polishing pad of claim ~~33~~29, wherein the combination of the transparent region of the foundation layer and the portion of the back surface of the polishing surface layer underneath the opening is effectively transparent for transmission of light for end-point detection.

5361. The polishing pad of claim ~~33~~29, wherein the transparent region of the foundation layer is nonporous.

5462. The polishing pad of claim ~~33~~29, wherein the foundation layer extends beyond the polishing surface layer.

5563. The polishing pad of claim ~~33~~29, wherein the polishing surface layer extends beyond the foundation layer.

5664. The polishing pad of claim ~~33~~29, further comprising:

a sub pad having an aperture, wherein the foundation layer is disposed proximate to the sub pad, and wherein the aperture of the sub pad is aligned with the transparent region of the foundation layer.

~~65. A method of fabricating a polishing pad for polishing a substrate, the method comprising:~~

~~providing, in a formation mold, a foundation layer and a mixture formed from mixing a set of polymerizable materials, the foundation layer having a transparent region;~~

~~coupling a pattern of protrusions of the formation mold with the mixture; and, with the pattern of protrusions coupled with the mixture,~~

~~at least partially curing the mixture to form a molded homogeneous polishing surface layer directly on the foundation layer, the molded homogeneous polishing surface~~

~~layer comprising a pattern of grooves corresponding to the pattern of protrusions of the formation mold; and~~

~~forming an aperture or opening in the polishing surface layer, aligned with the transparent region of the foundation layer.~~

~~66. The method of claim 65, wherein the aperture or opening is formed during formation of the polishing surface layer.~~

~~67. The method of claim 65, wherein the aperture or opening is formed subsequent to formation of the polishing surface layer.~~

~~68. The method of claim 65, further comprising:~~

~~removing the foundation layer having the molded homogeneous polishing surface layer formed thereon from the formation mold when the extent of curing is sufficient to maintain geometry of the molded homogeneous polishing surface layer but insufficient for the molded homogeneous polishing surface layer to withstand mechanical stress.~~

~~69. The method of claim 68, wherein the foundation layer extends beyond the molded homogeneous polishing surface layer.~~

~~70. The method of claim 69, wherein removing the foundation layer having the molded homogeneous polishing surface layer formed thereon from the base of the formation mold comprises taking hold of the foundation layer but not the molded homogeneous polishing surface layer.~~

~~71. The method of claim 69, further comprising:~~

~~cutting away the portion of the foundation layer that extends beyond the molded homogeneous polishing surface layer.~~

~~72. The method of claim 65, wherein the molded homogeneous polishing surface layer extends beyond the foundation layer.~~

~~73. The method of claim 65, wherein at least partially curing the mixture comprises heating both the mixture and the foundation layer.~~

~~74. The method of claim 65, further comprising:~~

~~removing the molded homogeneous polishing surface layer from the foundation layer; and forming a second homogeneous polishing surface layer on the foundation layer.~~

~~75. The method of claim 65, wherein providing the foundation layer in the formation mold comprises first removing a previously formed polishing surface layer from the foundation layer.~~

~~76. The method of claim 65, wherein providing the foundation layer in the formation mold comprises first roughening a surface of the foundation layer.~~

~~77. The method of claim 65, wherein forming the molded homogeneous polishing surface layer comprises forming a thermoset polyurethane material.~~

~~78. The method of claim 65, wherein mixing the set o~~
~~comprises adding a plurality of porogens to the set of~~
~~plurality of closed cell pores in the molded homogene~~
~~closed cell pore having a physical shell.~~

~~79. The method of claim 65, wherein mixing the set o~~
~~comprises injecting a gas into the set of polymerizabl~~
~~there from, to form a plurality of closed cell pores in~~
~~surface layer, each closed cell pore having no physica~~

~~80. The method of claim 65, wherein mixing the set o~~
~~mixing an isocyanate and an aromatic diamine compo~~

~~81. The method of claim 65, wherein mixing the set o~~
~~comprises adding an opacifying particle filler to the s~~
~~an opaque molded homogeneous polishing surface lay~~

~~82. The method of claim 65, further comprising:~~
~~further curing the molded homogeneous polish~~
~~foundation layer having the molded homogeneous pol~~