[0016] The functionally graded pads described here, having spatial variations of the pad tribological/material properties, are suitable for CMP processes on these new technologies, even for those using sub-130nm technology nodes.

SUMMARY

[0016a] In one aspect, there is provided a polishing pad for polishing a substrate, the polishing pad comprising:

a polishing body having a polishing surface and comprising a polymer matrix, the polishing body comprising:

a first region of the polymer matrix including a first region of the polishing surface, the first region having a first hardness and a first porosity; and

a second region of the polymer matrix including a second region of the polishing surface, the second region having a second hardness and a second porosity, wherein the second hardness is different than the first hardness and the second porosity is different than the first porosity, wherein the first region and second region are co-molded, and wherein the polishing body is continuously graded between the first region and the second region.

[0017] Described is a functionally graded polishing pad for a CMP process made up of a polishing pad having a polishing surface for polishing a silicon-containing wafer that is configured for use in a CMP procedure, wherein the polishing surface is one piece, substantially flat, and comprises at least two areas having differing physical characteristics. The at least two areas may have discrete boundaries or boundaries that are formed of mixtures of constituent polymers. The at least two areas may each comprise a compositionally different polymeric material and the region between the areas may comprise mixtures of the compositionally different polymeric materials.

[0018] The shape of at least one of the at least two areas may be annular, an island., or of random shape. The at least two areas each comprise a different polymeric material having different physical parameters and the change in composition between the at least two areas may be a step change, a continuous change., or a combination. The pad may have an edge and a center and the edge comprises one area and the center comprises another area and the change in composition between the edge and the center may be continuous or step or another form.

[0019] The functionally graded polishing pad may be made by the process of sequential or simultaneous injection molding of at least two polymeric compositions to form said at least two areas. The functionally graded polishing pad may have at least one of the at least two polymeric compositions comprising a block copolymer, perhaps where the block copolymer has differing constituent polymeric composition in the block copolymer over distance.

[0020] In a graded pad, the key pad mechanical properties like hardness, modulus amongst other and physical properties like porosity are varied spatially. Several types of grading can be conceived of which include patterns that can be classified as annular grading, island grading and step grading. Many other grading patterns are possible depending on the type of operation. The most appropriate pad grading for a particular operation is developed using simulation methods based on parameters which include the wafer sweep and it's residence time distribution during CMP, coefficient of friction and other physical properties.