55 degrees, 6o degrees and 65 degrees. Furthermore, it is possible to change the order of the polishing regions. As polishing pad 210 rotates, the biased grooves sweep the wafer to improve removal rate and additional radial feeder grooves facilitate polishing fluid distribution. With this embodiment, it is advantageous for the radial feeder grooves 220, 222, 224, 226, 228, 230, 232 and 234 to have a larger cross section than the biased grooves to improve distribution of the polishing fluid.

[0089] Referring to Figures 8 and 8A, curving the biased grooves 810 and 860 of polishing pads 800 and 850, respectively can facilitate uniform flow of polishing fluid over groove land areas. Polishing pads 800 and 850 have outward bias grooves 810 and 860. As the polishing pads 800 and 850 rotate, polishing fluid flows out the grooves 810 and 860 toward the outer edge 812 and 862. In grooves 810 and 860, the outward slope of the grooves diminish as it travels outward, this slows outward velocity and facilitates polishing fluid wetting the land areas toward the end of the grooves 810 and 860 during both clockwise and counterclockwise rotation.

[0090] For these configurations and for purposes of the specification, the bias angle θ equals the average angle of the curved biased grooves in relation to the bisect line represented by a dashed line. One method for measuring bias angle as seen in Figure 8 is to draw an imaginary line 8-8 that connects adjacent radial feeder grooves 820 and 830 along a single curved biased groove, then measure the angle of intersection (θ) or bias angle with dashed bisect line B_8. Similarly, for Figure8A, imaginary line 8a-8a connects adjacent radial feeder grooves 870 and 872 along a single curved bias groove, then measuring the angle of intersection with dashed bisect line B_{8a} equals the bias angle, θ. It is important that at least a majority of each curved bias segment have either an inward or outward angle. Advantageously, a majority of the bias grooves have the same bias. This is because having an inward biased groove portion with an outward biased groove portion will tend to cancel each other out with respect to removal rate. Advantageously, all the bias segments have either an inward or outward bias.

[0091] Referring to Figures 9, polishing pad 900 has curved radial feeder grooves 910, 912, 914 and 916. The feeder grooves 910, 912, 914 and 916 curve counter counterclockwise to improve fluid flow for clockwise rotation of polishing pad 900. This shape accelerates outward flow of the polishing fluid to improve polishing fluid distribution to outer bias grooves 920 during clockwise rotation and decelerates outward flow to decrease polishing fluid distribution to outer bias grooves 920 during counterclockwise rotation. Alternatively, the radial feeder grooves could curve in a clockwise direction (not shown) for the opposite

CLAIMS

1. A method for polishing or planarizing a wafer of at least one of semiconductor, optical and magnetic substrates, the method comprising the following:

rotating a polishing pad, the rotating polishing pad having a polishing layer having a polymeric matrix and a thickness, the polishing layer including a center, an outer edge and a radius extending from the center to the outer edge of the polishing pad; radial feeder grooves in the polishing layer separating the polishing layer into polishing regions, the polishing regions being circular sectors defined by two adjacent radial feeder grooves, the polishing regions having a bias for adjusting residence time under the wafer, the bias having a bias angle θ between a bisect line bisecting polishing regions and biased grooves connecting adjacent feeder grooves, the bias angle θ being either an inward bias angle θ sloped inward toward the center of the polishing pad or an outward bias angle θ sloped outward toward the outer edge of the polishing pad, a majority of the biased grooves sweeping the wafer in the same direction under the wafer, the radial feeder grooves extending at least from a location adjacent the center to a location adjacent the outer edge; and each polishing region including a series of biased grooves connecting a pair of adjacent radial feeder grooves, the majority of the biased grooves having either an inward bias toward the center of the polishing pad or an outward bias toward the outer edge of the polishing pad, both the inward and outward biased grooves moving polishing fluid toward the outer edge of the polishing pad and either toward the wafer or away from the wafer depending upon inward bias or outward bias and the direction of rotation of the polishing pad;

distributing polishing fluid onto the rotating polishing pad and into the radial feeder grooves and the series of biased grooves; and

pressing and rotating the wafer against the rotating polishing pad for multiple rotations of the polishing pad to adjust polishing by selecting either i) to increase residence time of the polishing fluid with outward flow of the polishing fluid in the series of biased grooves in the circular sectors under the wafer for the series of biased grooves inward bias toward the center of the rotating polishing pad during counterclockwise rotation of the polishing pad, or ii) to increase residence time of the polishing fluid with outward flow of the polishing fluid in the series of biased grooves in the circular sectors under the wafer for the series of biased grooves outward bias toward the outer edge of the rotating polishing pad during clockwise rotation of the polishing pad and wherein non-alignment of bias grooves

between adjacent polishing regions facilitates polishing fluid flow down the radial feeder grooves to improve slurry distribution.

2. The method of claim 1 wherein the wafer remains positioned at a location along the radius from the center of the polishing pad closer to the outer edge of the polishing pad then the center of the polishing pad to increase removal rate of at least one component of the wafer.

3. The method of claim 1 wherein rotating the polishing pad sends used polishing fluid through a portion of the series of biased grooves over the outer edge of the polishing pad to allow flow of new polishing fluid under the wafer.

4. The method of claim 1 wherein the series of biased grooves represent parallel grooves that increase residence time of the polishing fluid under the wafer.

5. A method for polishing or planarizing a wafer of at least one of semiconductor, optical and magnetic substrates, the method comprising the following:

rotating a polishing pad, the rotating polishing pad having a polishing layer having a polymeric matrix and a thickness, the polishing layer including a center, an outer edge and a radius extending from the center to the outer edge of the polishing pad; radial feeder grooves in the polishing layer separating the polishing layer into polishing regions, the polishing regions being circular sectors defined by two adjacent radial feeder grooves, the polishing regions having a bias for adjusting residence time under the wafer, the bias having a bias angle θ between a bisect line bisecting polishing regions and sloped grooves connecting adjacent feeder grooves, the bias angle θ being either an inward bias angle θ sloped inward toward the center of the polishing pad or an outward bias angle θ sloped outward toward the outer edge of the polishing pad, a majority of the biased grooves sweeping the wafer in the same direction, a bisect line bisecting the polishing regions, the radial feeder grooves extending at least from a location adjacent the center to a location adjacent the outer edge; and each polishing region including a series of biased grooves connecting a pair of adjacent radial feeder grooves, the majority of the biased grooves having either an inward bias toward the center of the polishing pad at an angle of 20° to 85° from the bisect line or an outward bias toward the outer edge of the polishing pad at an angle of 95° to 160° from the bisect line,

both the inward and outward biased grooves moving polishing fluid toward the outer edge of the polishing pad and either toward the wafer or away from the wafer depending upon inward bias or outward bias and the direction of rotation of the polishing pad;

distributing polishing fluid onto the rotating polishing pad and into the radial feeder grooves and the series of biased grooves; and

pressing and rotating the wafer against the rotating polishing pad for multiple rotations of the polishing pad to adjust polishing by selecting either i) to increase residence time of the polishing fluid with outward flow of the polishing fluid in the series of biased grooves in the circular sectors under the wafer for the series of biased grooves inward bias toward the center of the rotating polishing pad during counterclockwise rotation of the polishing pad, or ii) to increase residence time of the polishing fluid with outward flow of the polishing fluid in the series of biased grooves in the circular sectors under the wafer for the series of biased grooves outward bias toward the outer edge of the rotating polishing pad during clockwise rotation of the polishing pad and wherein non-alignment of bias grooves between adjacent polishing regions facilitates polishing fluid flow down the radial feeder grooves to improve slurry distribution.

6. The method of claim 5 wherein the wafer remains positioned at a location along the radius from the center of the polishing pad closer to the outer edge of the polishing pad then the center of the polishing pad to increase removal rate of at least one component of the wafer.

7. The method of claim 5 wherein rotating the polishing pad sends used polishing fluid through a portion of the series of biased grooves over the outer edge of the polishing pad to allow flow of new polishing fluid under the wafer.

8. The method of claim 5 wherein the series of biased grooves represent parallel grooves that increase residence time of the polishing fluid under the wafer.