

the two side surfaces 2 and are inclined to the inner periphery, and a V-shaped bottom face 12 formed between the two inclined faces 11.

A groove B 206 illustrated in FIG. 2F has a bottom face 14 which is formed between two side surfaces 13 and is parallel to the polishing surface 1. In the groove B 206, angles θ_B' formed between the polishing surface 1 and the side surfaces 213 continuous with the polishing surface 1 are an acute angle.

[0028] Further, the side surface continuous with the polishing surface in the groove B may be a curved line, a polygonal line, a straight line having a plurality of folding points, a wavy line, or a combination thereof in addition to a straight line, as long as the angle formed with respect to the polishing surface on the edge can be maintained to be 60 degrees or larger and 105 degrees or smaller even when the polishing pad is worn.

[0029] Herein, it is not necessary to form the polishing pad by using one kind of the groove B, but the polishing pad may be formed by a combination of grooves having a plurality of different cross-sections. Incidentally, from the viewpoint of the in-plane uniformity, it is preferable to form the polishing pad by using one kind of the groove.

[0030] The groove formed on the polishing surface is defined by the area ratio of the groove formed per area of the polishing surface. The groove-area ratio of the groove, which is formed on the polishing surface, per unitary unit is preferably 5% or higher and 50% or lower. In particular, the lower limit of the groove-area ratio per unitary unit is preferably 10% or higher, and more preferably 15% or higher. In addition, the upper limit of the groove-area ratio per unitary unit is more preferably 45% or lower, and even more preferably 40% or lower.

A unitary unit 309 illustrated in FIG. 3I includes a combination of three adjacent grooves A and one groove B (arrangement pattern: AAAB).

[0033] Meanwhile, an area occupying ratio of the groove A per groove area is an area ratio of the groove A per area of groove which is formed on the polishing surface. The area occupying ratio of the groove A per area of groove which is formed on the polishing surface is preferably 30% or higher and 90% or lower, more preferably 40% or higher, and even more preferably 50% or higher. Moreover, the area occupying ratio of the groove A per groove area is more preferably 80% or lower, and even more preferably 70% or lower.

[0034] A groove, which a general polishing pad may have, may be provided on the surface of the polishing layer of the polishing pad in a lattice form, a dimple form, a spiral form, a concentric circle form, or the like, in order to suppress a hydroplane phenomenon or to prevent the wafer and the pad from being sucked with each other. A combination of these forms is preferably used, but in particular, a lattice form is preferable. The lattice form is a form by combining lines on a grid at a right angle. In the lattice form, there are a plurality of cases where grooves in a vertical direction and a horizontal direction have equal intervals, the intervals of grooves in the vertical direction are narrower than the intervals of grooves in the horizontal direction, and the intervals of grooves in the horizontal direction are narrower than the intervals of grooves in the vertical direction.

[0035] The groove A formed on the polishing surface of the polishing layer of the polishing pad contributes to a high polishing rate and an excellent in-plane uniformity as described above. However, the balance between the supplying and discharging

of slurry is deteriorated in accordance with decrease in the cross-sectional area at the final period of lifetime of the polishing pad. According to this, defects are increased. Therefore, for grooves formed on the polishing surface, the sum total of groove lengths of the grooves A formed on the entire polishing surface is preferably 10% or higher and 90% or lower, more preferably 20% or higher, even more preferably 25% or higher, even more preferably 30% or higher, and particularly preferably 35% or higher of the sum total of groove lengths of the grooves formed on the polishing surface. Moreover, the sum total of groove lengths of the grooves A formed on the entire polishing surface is more preferably 80% or lower, even more preferably 70% or lower, even more preferably 60% or lower, and particularly preferably 55% or lower.

[0036] When a ratio of the sum total of groove lengths of the grooves A formed on the entire polishing surface to the sum total of groove lengths of all grooves is within the above-described range, the suction force acts between the wafer and the polishing pad and an effect of increasing a polishing rate is exhibited. Moreover, as a forming method of grooves formed on the polishing surface of the polishing layer of the polishing pad, a method may be employed in which the groove A is formed to be concentrated on the center of the polishing pad and the groove B is formed on the remaining portion. When the polishing surface of the polishing pad is circular, the groove A is formed in an area where two straight lines passing through the center of the polishing surface and intersected with each other are included and a distance from at least one of two straight lines is preferably 70% or lower, more preferably 60% or lower, even more preferably 50% or lower, and particularly preferably 40% or lower of the radius of the polishing surface.

intersection point of diagonal lines of the sheet toward one end thereof were measured and an average of these three points was set as an inclination angle.

[0071] <Average Polishing Rate Measurement and In-plane Uniformity>

The polishing was carried out using Mirra 3400 manufactured by Applied Material Co., Ltd. under a predetermined polishing condition while performing endpoint detection. An average polishing rate as polishing characteristics was obtained in such a manner that polishing rates (nm/min) were measured by excluding 10 mm of the outmost circumference of the 8-inch wafer. The in-plane uniformity was obtained by dividing the standard deviation of the polishing rate by a difference between the maximum value and the minimum value of the polishing rates.

[0072] <Defect Evaluation>

As an enhancement process, after the polished wafer was immersed for 10 minutes in 0.5% by weight of hydrofluoric acid and then washed with water, the wafer was washed with a mixture solution of 1.0% by weight of ammonia and 1.0% by weight of hydrogen peroxide and then washed with water to be dried. The number of defects of 0.155 μm or greater was counted on the washed wafer, using SP-1 manufactured by KLA-Tencor Co., Ltd.

[0073] <Pad Grinding Rate>

The depth of the groove before and after polishing was measured using a depth gauge (digimatic type) manufactured by Mitutoyo Corporation, and a pad grinding rate was obtained by dividing a reduced value of the groove by a time of using a disk which was being evaluated.

[0074] <Ratio of the Number of Grooves A>

The polishing pad including the groove formed on the polishing surface of the polishing layer was sliced in parallel to the groove so