CLAIMS

[Claim 1] A polishing method comprising:

rotating a polishing table that supports a polishing pad; and

polishing a substrate by pressing the substrate against a polishing surface of the polishing pad by a polishing head, the substrate having a multilayered structure including a dielectric film and a stopper layer formed under the dielectric film,

wherein polishing the substrate includes a film-thickness profile adjustment process and a polishing-end-point detection process performed after the film-thickness profile adjustment process,

the film-thickness profile adjustment process includes measuring a plurality of film thicknesses at a plurality of measurement points on the substrate, adjusting pressing forces on the substrate against the polishing surface based on the plurality of film thicknesses such that a surface, to be polished, of the substrate becomes flat,

the film-thickness profile adjustment process is terminated when a film-thickness index value has reached a film-thickness threshold value,

the polishing-end-point detection process includes measuring a torque for rotating the polishing table and determining a polishing end point of the substrate based on the torque,

the film-thickness index value is one of an average of the plurality of film thicknesses, a film thickness at a measurement point selected from the plurality of measurement points, a maximum of the plurality of film thicknesses, and a minimum of the plurality of film thicknesses, and

the film-thickness threshold value is determined based on a point in time at which the dielectric film is thin enough for the polishing-end-point detection process to be able to accurately detect the polishing end point.

[Claim 2] The polishing method according to claim 1, wherein measuring the plurality of film thicknesses includes irradiating the substrate with light, generating a

plurality of spectra of reflected light from the plurality of measurement points on the substrate, and determining the plurality of film thicknesses based on the plurality of spectra.

[Claim 3] The polishing method according to claim 1 or 2, wherein polishing the substrate further includes an initial polishing process performed before the film-thickness profile adjustment process, the initial polishing process including measuring a torque for rotating the polishing table and determining an initial polishing end point based on the torque.

[Claim 4] A computer-readable storage medium storing a program for causing a computer to perform:

instructing a table motor to rotate a polishing table that supports a polishing pad;

instructing a plurality of pressure regulators to adjust pressing forces on a substrate against a polishing surface of the polishing pad based on a plurality of film thicknesses at a plurality of measurement points on the substrate such that a surface, to be polished, of the substrate becomes flat when a polishing head is pressing the substrate against the polishing surface to polish the substrate, the polishing head having a plurality of pressure chambers coupled to the plurality of pressure regulators, the substrate having a multilayered structure including a dielectric film and a stopper layer formed under the dielectric film;

instructing the plurality of pressure regulators to terminate the adjusting of the pressing forces when a film-thickness index value has reached a film-thickness threshold value, the film-thickness index value being one of an average of the plurality of film thicknesses, a film thickness at a measurement point selected from the plurality of measurement points, a maximum of the plurality of film thicknesses, and a minimum of the plurality of film thicknesses; and

determining a polishing end point of the substrate based on a torque for rotating

the polishing table after determination of a point in time at which the film-thickness index value has reached the film-thickness threshold value, the film-thickness threshold value being determined based on a point in time at which the dielectric film is thin enough for allowing an accurate detection of the polishing end point.

[Claim 5] The computer-readable storage medium according to claim 4, wherein the program is configured to cause the computer to further perform determining an initial polishing end point based on a torque for rotating the polishing table when the substrate is being polished and before the plurality of pressure regulators adjust the pressing forces on the substrate against the polishing surface.

[Claim 6] A polishing apparatus for polishing a substrate having a multilayered structure including a dielectric film and a stopper layer formed under the dielectric film, comprising:

a polishing table configured to support a polishing pad;

a table motor configured to rotate the polishing table;

a polishing head having a plurality of pressure chambers for pressing the substrate against a polishing surface of the polishing pad;

a film-thickness measuring device configured to measure a plurality of film thicknesses at a plurality of measurement points on the substrate;

a plurality of pressure regulators coupled to the plurality of pressure chambers;

a torque measuring device configured to measure a torque for rotating the polishing table; and

an operation controller configured to control operations of the polishing apparatus,

wherein the operation controller is configured to:

perform a film-thickness profile adjustment process of instructing the plurality of pressure regulators to adjust pressing forces on the substrate against the

polishing surface based on the plurality of film thicknesses during polishing of the substrate such that a surface, to be polished, of the substrate becomes flat;

terminate the film-thickness profile adjustment process when a film-thickness index value has reached a film-thickness threshold value, the film-thickness index value being one of an average of the plurality of film thicknesses, a film thickness at a measurement point selected from the plurality of measurement points, a maximum of the plurality of film thicknesses, and a minimum of the plurality of film thicknesses; and

determine a polishing end point of the substrate based on the torque during polishing of the substrate and after the film-thickness profile adjustment process, the film-thickness threshold value being determined based on a point in time at which the dielectric film is thin enough for the polishing-end-point detection process to be able to accurately detect the polishing end point.

[Claim 7] The polishing apparatus according to claim 6, wherein the film-thickness measuring device is an optical film-thickness measuring device configured to measure a film thickness of the substrate based on a spectrum of reflected light from the substrate.

[Claim 8] The polishing apparatus according to claim 6 or 7, wherein the operation controller is configured to determine an initial polishing end point based on the torque for rotating the polishing table during polishing of the substrate and before the film-thickness profile adjustment process.