CLAIMS

[Claim 1]

A film-thickness measuring method comprising:

directing light to a substrate having a film formed on a surface thereof;

producing a spectral waveform indicating a relationship between intensity and wavelength of reflected light from the substrate;

performing Fourier transform processing on the spectral waveform to determine strengths of frequency components and corresponding film thicknesses;

determining a plurality of local maximum values of the strengths of the frequency components; and

selecting, according to a preset selection rule, one film thickness from a plurality of film thicknesses corresponding respectively to the plurality of local maximum values,

wherein the preset selection rule is either to select an N-th largest film thickness or to select an N-th smallest film thickness, N being a predetermined natural number,

wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with the same process as measuring of a film thickness of said substrate, and

wherein a process of determining the selection rule comprises:

calculating a magnitude of fluctuation of each of a plurality of local maximum values which are determined during measuring of the film thickness of the reference substrate; and

selecting a film thickness corresponding to a local maximum value whose magnitude of fluctuation is the smallest.

[Claim 2] The film-thickness measuring method according to claim 1, wherein the plurality of local maximum values are determined based on a comparison with a threshold

value.

[Claim 3] The film-thickness measuring method according to claim 2, wherein the threshold value is a value determined from a previous measurement result of a film thickness.

[Claim 4] The film-thickness measuring method according to claim 1, wherein measuring of the film thickness of the reference substrate is performed while water-polishing the reference substrate.

[Claim 5]

A film-thickness measuring method comprising:

directing light to a substrate having a film formed on a surface thereof;

producing a spectral waveform indicating a relationship between intensity and wavelength of reflected light from the substrate;

performing Fourier transform processing on the spectral waveform to determine strengths of frequency components and corresponding film thicknesses;

determining a plurality of local maximum values of the strengths of the frequency components; and

selecting, according to a preset selection rule, one film thickness from a plurality of film thicknesses corresponding respectively to the plurality of local maximum values,

wherein the preset selection rule is either to select an N-th largest film thickness or to select an N-th smallest film thickness, N being a predetermined natural number,

wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with the same process as measuring of a film thickness of said substrate, and

wherein a process of determining the selection rule comprises:

comparing a plurality of local maximum values with each other each time the local maximum values are determined during measuring of the film thickness of the reference substrate, thereby determining a largest local maximum value;

identifying a film thickness corresponding to the largest local maximum value; and

selecting a film thickness which has been most frequently identified.

[Claim 6]

A film-thickness measuring apparatus comprising:

a light emitter configured to direct light to a substrate having a film formed on a surface thereof;

a light receiver configured to receive reflected light from the substrate;

a spectrometer configured to measure an intensity of the reflected light at each of wavelengths; and

a processor configured to produce a spectral waveform indicating a relationship between intensity and wavelength of the reflected light, the processor being configured to

perform Fourier transform processing on the spectral waveform to determine strengths of frequency components and corresponding film thicknesses,

determine a plurality of local maximum values of the strengths of the frequency components, and

select, according to a preset selection rule, one film thickness from a plurality of film thicknesses corresponding respectively to the plurality of local maximum values,

wherein the preset selection rule is either to select an N-th largest film thickness or to select an N-th smallest film thickness, N being a predetermined natural number,

wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with

the same process as measuring of a film thickness of said substrate, and

wherein the selection rule is determined by:

calculating a magnitude of fluctuation of each of a plurality of local maximum values which are determined during measuring of the film thickness of the reference substrate; and

selecting a film thickness corresponding to a local maximum value whose magnitude of fluctuation is the smallest.

[Claim 7] The film-thickness measuring apparatus according to claim 6~~–9~~, wherein the processor is configured to determine the plurality of local maximum values based on a comparison with a threshold value.

[Claim 8] A film-thickness measuring apparatus comprising:

a light emitter configured to direct light to a substrate having a film formed on a surface thereof;

a light receiver configured to receive reflected light from the substrate;

a spectrometer configured to measure an intensity of the reflected light at each of wavelengths; and

a processor configured to produce a spectral waveform indicating a relationship between intensity and wavelength of the reflected light, the processor being configured to

perform Fourier transform processing on the spectral waveform to determine strengths of frequency components and corresponding film thicknesses,

determine a plurality of local maximum values of the strengths of the frequency components, and

select, according to a preset selection rule, one film thickness from a plurality of film thicknesses corresponding respectively to the plurality of local maximum values,

wherein the preset selection rule is either to select an N-th largest film thickness or to select an N-th smallest film thickness, N being a predetermined natural number,

wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with the same process as measuring of a film thickness of said substrate, and

wherein the selection rule is determined by:

comparing a plurality of local maximum values with each other each time the local maximum values are determined during measuring of the film thickness of the reference substrate, thereby determining a largest local maximum value;

identifying a film thickness corresponding to the largest local maximum value; and

selecting a film thickness which has been most frequently identified.

[Claim 9]

A polishing method comprising:

pressing a substrate against a polishing surface of the polishing pad attached to a polishing table, while rotating the polishing table, the substrate having a film whose thickness varies between a first portion and a second portion of the film;

directing light to a plurality of measuring points on the substrate each time the polishing table makes one revolution;

producing a spectral waveform indicating a relationship between intensity and wavelength of reflected light from the substrate;

performing Fourier transform processing on the spectral waveform to determine strengths of frequency components and corresponding film thicknesses;

determining a plurality of local maximum values of the strengths of the frequency components; and

selecting, according to a preset selection rule, one film thickness from a plurality of film thicknesses corresponding respectively to the plurality of local maximum values,

wherein the preset selection rule is either to select an N-th largest film thickness or to select an N-th smallest film thickness, N being a predetermined natural number.

[Claim 10] The polishing method according to claim 9, further comprising:

terminating polishing of the substrate when the selected film thickness reaches a preset target value.

[Claim 11] The polishing method according to claim 10, further comprising:

calculating a corrected target value by adding an offset value to the target value, wherein polishing of the substrate is terminated when the selected film thickness reaches the corrected target value.

[Claim 12] The polishing method according to claim 9, wherein the plurality of local maximum values are determined based on a comparison with a threshold value.

[Claim 13]

The polishing method according to claim 9, wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with the same process as measuring of a film thickness of said substrate, and

wherein a process of determining the selection rule comprises:

calculating a magnitude of fluctuation of each of a plurality of local maximum values which are determined during measuring of the film thickness of the reference substrate; and

selecting a film thickness corresponding to a local maximum value whose magnitude of fluctuation is the smallest.

[Claim 14]

The polishing method according to claim 9, wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with the same process as measuring of a film thickness of said substrate, and

wherein the selection rule is determined by:

comparing a plurality of local maximum values with each other each time the local maximum values are determined during measuring of the film thickness of the reference substrate, thereby determining a largest local maximum value;

identifying a film thickness corresponding to the largest local maximum value; and

selecting a film thickness which has been most frequently identified.

[Claim 15] A polishing apparatus comprising:

a rotatable polishing table configured to support a polishing pad having a polishing surface;

a polishing head configured to press a substrate, having a film formed on a surface thereof, against the polishing surface, the film having thickness that varies between a first portion and a second portion of the film;

a light emitter configured to direct light to a plurality of measuring points on the substrate each time the polishing table makes one revolution;

a light receiver configured to receive reflected light from the substrate;

a spectrometer configured to measure an intensity of the reflected light at each of wavelengths;

a processor configured to produce a spectral waveform indicating a relationship between intensity and wavelength of the reflected light; and

a polishing controller configured to control polishing of the substrate, the

processor being configured to:

perform Fourier transform processing on the spectral waveform to determine strengths of frequency components and corresponding film thicknesses,

determine a plurality of local maximum values of the strengths of the frequency components, and

select, according to a preset selection rule, one film thickness from a plurality of film thicknesses corresponding respectively to the plurality of local maximum values,

wherein the preset selection rule is either to select an N-th largest film thickness or to select an N-th smallest film thickness, N being a predetermined natural number.

[Claim 16] The polishing apparatus according to claim 15, wherein the polishing controller is configured to terminate polishing of the substrate when the selected film thickness reaches a preset target value.

[Claim 17] The polishing apparatus according to claim 16, wherein the polishing controller is configured to calculate a corrected target value by adding an offset value to the target value, and terminate polishing of the substrate when the selected film thickness reaches the corrected target value.

[Claim 18] The polishing apparatus according to claim 15, wherein the processor is configured to determine the plurality of local maximum values based on a comparison with a threshold value.

[Claim 19]

The polishing apparatus according to claim 15, wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with the same process as measuring of a film

thickness of said substrate, and

wherein the selection rule is determined by:

calculating a magnitude of fluctuation of each of a plurality of local maximum values which are determined during measuring of the film thickness of the reference substrate; and

selecting a film thickness corresponding to a local maximum value whose magnitude of fluctuation is the smallest.

[Claim 20]

The polishing apparatus according to claim 15, wherein the preset selection rule is predetermined based on a result of measuring a film thickness of a reference substrate having the same structure as said substrate, measuring of the film thickness of the reference substrate being performed with the same process as measuring of a film thickness of said substrate, and

wherein the selection rule is determined by:

comparing a plurality of local maximum values with each other each time the local maximum values are determined during measuring of the film thickness of the reference substrate, thereby determining a largest local maximum value;

identifying a film thickness corresponding to the largest local maximum value; and

selecting a film thickness which has been most frequently identified.