WHAT IS CLAIMED IS:

1. A laser processing apparatus comprising:

a chuck table for holding a workpiece thereon;

a laser beam applying unit for applying a laser beam to the workpiece held on the chuck table; and

a control unit,

wherein the laser beam applying unit includes

a laser oscillator for oscillating a laser,

a condensing lens for converging the laser beam emitted from the laser oscillator,

a concave mirror positioned to have a focal point at a focused spot of the condensing lens and having a spherical reflecting surface for reflecting the laser beam,

a beam splitter for transmitting therethrough the laser beam emitted from the laser oscillator toward the condensing lens and branching off a reflected beam of the laser beam converged by the condensing lens and reflected by the reflecting surface of the concave mirror, and

a wavefront measuring unit for receiving the reflected beam reflected by the reflecting surface of the concave mirror and branched off by the beam splitter and acquiring wavefront data representing a spatial phase

distribution of the laser beam, ~~and~~

wherein the control unit changes a phase pattern to be displayed on a display portion of a spatial light modulator disposed between the laser oscillator and the condensing lens on a basis of the wavefront data measured by the wavefront measuring unit, and the control unit includes

a calculating section for approximating, by a Zernike polynomial, the wavefront data measured by the wavefront measuring unit and representing the spatial phase distribution of the laser beam and for calculating Zernike coefficients thereof,

a phase pattern generating section for generating a phase pattern having predetermined Zernike coefficients and displaying the generated phase pattern on the display portion of the spatial light modulator,

a changing section for changing an arbitrary one of the Zernike coefficients of the wavefront data measured by the wavefront measuring unit, and

a determining section for determining whether or not the wavefront data measured by the wavefront measuring unit are close enough to ideal wavefront data, and

wherein the laser oscillator continues to emit the

laser beam, and the changing section changes an arbitrary one of the Zernike coefficients and the phase pattern generating section displays a phase pattern including the changed Zernike coefficient on the display portion of the spatial light modulator, alternately repeatedly until the determining section determines that the wavefront data measured by the wavefront measuring unit are close enough to the ideal wavefront data.

2. The laser processing apparatus according to claim 1, wherein the concave mirror is disposed in a peripheral edge portion of the chuck table.

3. A laser processing apparatus comprising:

a chuck table for holding a workpiece thereon;

a laser beam applying unit for applying a laser beam to the workpiece held on the chuck table; and

a control unit,

wherein the laser beam applying unit includes

a laser oscillator for oscillating a laser,

a condensing lens for converging the laser beam emitted from the laser oscillator,

a concave mirror positioned to have a focal point at a focused spot of the condensing lens and having a spherical reflecting surface for reflecting the laser beam,

a beam splitter for transmitting therethrough the laser beam emitted from the laser oscillator toward the condensing lens and branching off a reflected beam of the laser beam converged by the condensing lens and reflected by the reflecting surface of the concave mirror, and

a wavefront measuring unit for receiving the reflected beam reflected by the reflecting surface of the concave mirror and branched off by the beam splitter and acquiring wavefront data representing a spatial phase distribution of the laser beam,

wherein the control unit changes a phase pattern to be displayed on a display portion of a spatial light modulator disposed between the laser oscillator and the condensing lens on a basis of the wavefront data measured by the wavefront measuring unit, and ~~The laser processing apparatus according to claim 1,~~

wherein the control unit includes

a calculating section for approximating, by a Zernike polynomial, the wavefront data measured by the wavefront measuring unit and representing the spatial phase distribution of the laser beam and for calculating Zernike coefficients thereof,

a phase pattern generating section for

generating a phase pattern having predetermined Zernike coefficients and displaying the generated phase pattern on the display portion of the spatial light modulator, and

a storage section for storing in advance a correlation between Zernike coefficients input to the phase pattern and Zernike coefficients of the laser beam measured by the wavefront measuring unit when the phase pattern to which the Zernike coefficients are input is displayed on the display portion of the spatial light modulator, and

the phase pattern generating section calculates back Zernike coefficients input to the phase pattern to be displayed on the display portion so that the Zernike coefficients of the laser beam measured by the wavefront measuring unit are desired values, on a basis of a table of the correlation stored in the storage section.

~~4. The laser processing apparatus according to claim 1,~~

~~wherein the control unit includes~~

~~a calculating section for approximating, by a Zernike polynomial, the wavefront data measured by the wavefront measuring unit and representing the spatial phase distribution of the laser beam and for calculating~~

~~Zernike coefficients thereof,~~

~~a phase pattern generating section for generating a phase pattern having predetermined Zernike coefficients and displaying the generated phase pattern on the display portion of the spatial light modulator,~~

~~a changing section for changing an arbitrary one of the Zernike coefficients of the wavefront data measured by the wavefront measuring unit, and~~

~~a determining section for determining whether or not the wavefront data measured by the wavefront measuring unit are close enough to ideal wavefront data, and~~

~~wherein the laser oscillator continues to emit the laser beam, and the changing section changes an arbitrary one of the Zernike coefficients and the phase pattern generating section displays a phase pattern including the changed Zernike coefficient on the display portion of the spatial light modulator, alternately repeatedly until the determining section determines that the wavefront data measured by the wavefront measuring unit are close enough to the ideal wavefront data.~~

4~~5~~. A method of adjusting a phase pattern to be displayed on a display portion of a laser processing apparatus including a laser beam applying unit for

applying a laser beam to a workpiece held on a chuck table,

the laser beam applying unit including

a laser oscillator for oscillating a laser,

a condensing lens for converging the laser beam emitted from the laser oscillator,

a concave mirror positioned to have a focal point at a focused spot of the condensing lens and having a spherical reflecting surface for reflecting the laser beam,

a beam splitter for transmitting therethrough the laser beam emitted from the laser oscillator toward the condensing lens and branching off a reflected beam of the laser beam converged by the condensing lens and reflected by the reflecting surface of the concave mirror,

a wavefront measuring unit for receiving the reflected beam reflected by the reflecting surface of the concave mirror and branched off by the beam splitter and acquiring wavefront data representing a spatial phase distribution of the laser beam, and

a spatial light modulator disposed between the laser oscillator and the condensing lens and having a display portion for adjusting optical characteristics of

the laser beam emitted from the laser oscillator,

the method of adjusting the phase pattern comprising:

a Zernike coefficient input step of displaying a phase pattern having predetermined Zernike coefficients on the display portion of the spatial light modulator;

a laser beam applying step of emitting the laser beam from the laser oscillator and acquiring wavefront data thereof by the wavefront measuring unit; and

a Zernike coefficient adjusting step of changing an arbitrary one of the Zernike coefficients of the wavefront data measured by the wavefront measuring unit and displaying a phase pattern including the changed Zernike coefficient on the display portion of the spatial light modulator,

wherein the Zernike coefficient adjusting step is repeated until the wavefront data measured by the wavefront measuring unit are close enough to ideal wavefront data.

56. The method according to claim 45, further comprising:

a Zernike coefficient back-calculating step of calculating back Zernike coefficients input to the phase pattern to be displayed on the display portion so that

the Zernike coefficients of the laser beam measured by the wavefront measuring unit are desired values, on a basis of a table of a correlation between Zernike coefficients input to the phase pattern and Zernike coefficients of the laser beam measured by the wavefront measuring unit when the phase pattern to which the Zernike coefficients are input is displayed on the display portion of the spatial light modulator.