WHAT IS CLAIMED IS:

1. A processing apparatus for processing a wafer, the processing apparatus comprising:

a main body;

a holding unit configured to hold the wafer, the holding unit being movably provided relative to the main body;

a processing unit configured to irradiate the wafer held by the holding unit with a laser beam, at least a part of the processing unit being movably provided relative to the main body;

a moving unit configured to move the holding unit and the at least part of the processing unit relative to each other;

a vibration detecting unit configured to detect vibration in the processing apparatus, the vibration detecting unit being movable relative to the main body; and

a control unit configured to control the holding unit, the processing unit, the moving unit, and the vibration detecting unit;

the vibration detecting unit including

a light source,

an interference unit configured to apply

light emitted from the light source to a measurement target member and generate an interference pattern image including an interference pattern of the measurement target member, and

an imaging unit configured to capture the interference pattern image of the measurement target member, the interference pattern image being generated by the interference unit;

wherein the interference unit is configured to generate the interference pattern image by interference between reflected light obtained by one light flux of two light fluxes branched from the light emitted from the light source being reflected by the measurement target member and reference light generated from the other light flux;

the control unit including

a storage section configured to store a first interference pattern image captured at a predetermined timing by the imaging unit and a second interference pattern image captured at a timing different from the timing of the first interference pattern image by the imaging unit,

a comparing section configured to compare the first interference pattern image and the second

interference pattern image stored in the storage section with each other, and

a vibration detecting section configured to detect vibration in the processing apparatus on a basis of the first interference pattern image and the second interference pattern image compared with each other by the comparing section.

2. The processing apparatus according to claim 1, wherein

the control unit further includes a three-dimensional image generating section configured to generate a three-dimensional image of the measurement target member on a basis of a plurality of interference pattern images captured while a position of the imaging unit is changed in a direction parallel with an imaging direction.

3. The processing apparatus according to claim 1, wherein

the measurement target member is the holding unit configured to hold the wafer.

4. A vibration detecting method for detecting vibration in a processing apparatus for processing a wafer,

the processing apparatus including:

a main body;

a holding unit configured to hold the wafer, the holding unit being movably provided relative to the main body;

a processing unit configured to irradiate the wafer held by the holding unit with a laser beam, at least a part of the processing unit being movably provided relative to the main body;

a moving unit configured to move the holding unit and the at least part of the processing unit relative to each other;

a vibration detecting unit configured to detect vibration in the processing apparatus, the vibration detecting unit being movable relative to the main body; and

a control unit configured to control the holding unit, the processing unit, the moving unit, and the vibration detecting unit,

the vibration detecting method comprising:

a light applying step of irradiating a measurement target member with light;

an imaging step of capturing an interference pattern image including an interference pattern generated by interference between reflected light obtained by the

light being branched into two light fluxes and one light flux of the two branched light fluxes being reflected by the measurement target member and reference light generated from the other light flux;

a storing step of storing the interference pattern image captured in the imaging step;

a comparing step of comparing a first interference pattern image captured at a predetermined timing with a second interference pattern image captured at a timing different from the timing of the first interference pattern image; and

a vibration detecting step of detecting vibration in the processing apparatus on a basis of the first interference pattern image and the second interference pattern image compared with each other in the comparing step.

5. The vibration detecting method according to claim 4, wherein

the measurement target member has a target pattern,

the imaging step captures an interference pattern image including the target pattern, and

the comparing step further compares a position of a first target pattern in the first interference pattern

image captured at the predetermined timing with a position of a second target pattern in the second interference pattern image captured at the timing different from the timing of the first interference pattern image.

6. The processing apparatus according to claim 1, wherein the reference light and the reflected light from the measurement target member are transmitted along a same path to the imaging unit.

7. The processing apparatus according to claim 1, wherein the interference unit include a half-silvered mirror configured to guide the one light flux of the two light fluxes to the measurement target member side and to guide the other light flux to a reference mirror side, the reference mirror being configured to generate the reference light.

8. The processing apparatus according to claim 1, wherein the comparing section is configured to compare a luminance distribution of the first interference pattern image with a luminance distribution of the second interference pattern image, and

the vibrating detecting section is configured to detect vibration in a Z-axis direction on a basis of a difference between the luminance distribution of the

first interference pattern image and the luminance distribution of the second interference pattern image.