single crystal silicon film) is cleaned by an aqueous solution of HF or an aqueous solution of a mixture of HF and H_2O_2 by which the surface of the silicon film is terminated by hydrogen and thereafter, the processed substrate **105** is incorporated in the cassette **304** and the cassette **304** is arranged in the load/unload chamber **306**.

In FIG. **3**, according to the embodiment, the processed substrate **105** transferred from load/unload chamber **306** is aligned and thereafter, transferred to the laser irradiation chamber **101**.

The processed substrate **105** transferred to the laser irradiation chamber **101** is mounted on the stage **111**. The gate valve **301** is closed in the state, and the inside of the laser irradiation chamber is evacuated by the vacuum exhaust pump **108**.

Thereafter, oxygen diluted by nitrogen is supplied from the gas supply tube **109** and hydrogen diluted by nitrogen is supplied from the supply tube **110**, respectively and an atmosphere, for example, constituted by oxygen 5%, hydrogen 5% and nitrogen 90% is produced. In this case, the pressure is set to the atmospheric pressure.

Further, in FIG. **1**, dimensions of a linear laser beam irradiated onto the processed substrate **105** are set to width 0.4 mm×length 135 mm. The energy density of the laser beam at the irradiated face is set to a range of 100 mJ/cm^2 through 500 mJ/cm^2, for example, 260 mJ/cm^2. The linear laser beam is scanned by moving the base **106** at a speed of 1.2 mm/s in one direction. Oscillation frequency of the laser is set to 30 Hz and in respect of one point of an irradiated object, 10 through 50 shots of laser beam are irradiated.

In this case, oxygen in the laser chamber and hydrogen in the laser chamber or hydrogen atoms on the surface of the non single crystal silicon film are reacted by the laser energy by which water molecules are formed. The aggregation of water molecules serves to maintain the temperature of the non single crystal silicon film, helps promote crystallization and significantly promotes the homogeneity of crystalline performance. The processed substrate **105** is cleaned by an aqueous solution of HF or an aqueous solution of a mixture of HF and H_2O_2 before laser irradiation and therefore, there is provided the moisture adsorbing and remaining on the surface of the silicon film by which the effect of maintaining the temperature of the substrate is promoted. According to the present invention, the moisture adsorbing and remaining on the surface of the silicon film is defined also as a portion of the temperature holding layer. The higher the temperature of the substrate, the higher the diffusion rate of the aggregation of water molecules by which temperature holding effect is attenuated. In this way, laser annealing is performed in respect of the non single crystal silicon films A, B and C whereby the crystallization is caused or the crystalline performance is promoted.

In respect of the atmosphere in the laser chamber of the embodiment, when the hydrogen concentration is changed in a range of 0.1% through 10%, the oxygen concentration is changed in a range of 0.1% through 10% and the pressure in the laser processing chamber is changed from several hundreds pascal to several atoms and the temperature of the substrate is changed from −10° C. to 100° C., an excellent result is obtained under any atmosphere. Even in an atmosphere which does not include hydrogen, water is formed so far as the atmosphere includes oxygen and therefore, the laser crystallization is effective also in an atmosphere which does not include hydrogen and includes oxygen. Thereafter, the substrate is incorporated to the cassette **304** of the load/unload chamber **306** via the robot arm **305**.

(Embodiment 6)

In this embodiment, a proof of forming water molecules by laser irradiation will be shown. FIGS. **10**(A) and **10**(B) are formed by counting a number of dusts in the laser irradiation chamber by a dust counter where the abscissa designates a particle size (μm) and the ordinate designates a number of particles (measured value). FIG. **10**(A) indicates the number of particles before laser irradiation. (The total number is 16. The sampling time period is 2' 06".) FIG. **10**(B) indicates a number of particles after performing laser irradiation while scanning the substrate (netted ones, the total number is **473**) and the number of particles counted after only scanning the substrate without laser irradiation (ones hatched in the right downward direction, the total number is **74**). (The sampling time period is 1' 39".) It is known that the counted value of the dust counter is significantly increased by the laser irradiation.

A majority of the particles detected by the dust counter after laser irradiation are provided with a particle size of about 0.3 μm. Hence, the inventors have inserted a filter **1103** having a pitch of 0.2 μm at the midway of an intake port **1102** of a dust counter **1101** and tried to catch particles **1104** after laser irradiation. (refer to FIG. **11**)

After laser irradiation, the filter is observed by an SEM. However, almost no particles have been observed. In view of the fact, it can be predicted that particles detected by the dust counter have been liquid particles. It is predicted that the liquid formed by laser irradiation is constituted by water in consideration of the object of laser irradiation.

According to the present invention, compared with all the conventional laser annealing technologies, the crystalline performance, the homogeneity are significantly promoted and the efficiency of using energy can considerably be promoted.

What is claimed is:

1. A method of performing laser annealing comprising:

irradiating a laser beam to a non single crystal semiconductor film in an atmosphere including at least oxygen and under a state where a surface of the non single crystal semiconductor film is intentionally terminated by hydrogen,

wherein a polycrystal semiconductor film in which an in-face dispersion of a mean roughness measured by an AFM of a surface of the semiconductor film constituted by polycrystals within ±20% is fabricated.

2. A method according to claim **1**, wherein the irradiation of the laser beam is performed in a state where a temperature of a substrate over which the semiconductor film is formed is maintained in a range of −10° C. to 100° C.

3. A method according to claim **1** wherein the laser beam is irradiated by scanning the laser beam a sectional shape at an irradiated face of which is in a spot-like shape or a linear shape.

4. A method according to claim **1** wherein the non single crystal semiconductor film is a non single crystal silicon film.

5. A method of performing laser annealing comprising:

irradiating a laser beam to a non-single crystal semiconductor film in an atmosphere including at least oxygen and under a state where a surface of the non-single crystal semiconductor film is intentionally terminated by hydrogen,

wherein a polycrystal semiconductor film having a standard deviation of a crystal grain size distribution that is ±20% or smaller is fabricated.

6. A method of performing laser annealing comprising: