WHAT IS CLAIMED IS:

1. A laser annealing treatment apparatus to crystallize an amorphous silicon semiconductor film by irradiating a pulsed laser light to the amorphous silicon semiconductor film with relatively scanning the pulse laser light with respect to the amorphous silicon semiconductor film, the laser annealing treatment apparatus comprising:

a laser light source that outputs pulse laser light;

an optical system that shapes the pulse laser light, and leads the shaped pulse laser light to a semiconductor film subject to treatment; and

a stage to be set the semiconductor film to be irradiated by the pulse laser light,

wherein the pulse laser light irradiating the semiconductor film, which the pulse laser light is obtained by superimposing or synthesizing a plurality of pulsed laser lights, presents a rising time equal to or less than 30 nanoseconds from 10% of the maximum height to the maximum height in the pulse energy density, and a falling time equal to or more than 80 nanoseconds from the maximum height to 10% of the maximum height.

2. The laser annealing treatment apparatus according to claim 1, wherein the rising time is equal to or less than 30 nanoseconds, and the falling time is equal to or more than 85 nanoseconds.

3. The laser annealing treatment apparatus according to claim 1 or 2, comprising a waveform shaping unit that shapes the pulse laser light output from the laser light source into a pulse waveform having the rising time and the falling time.

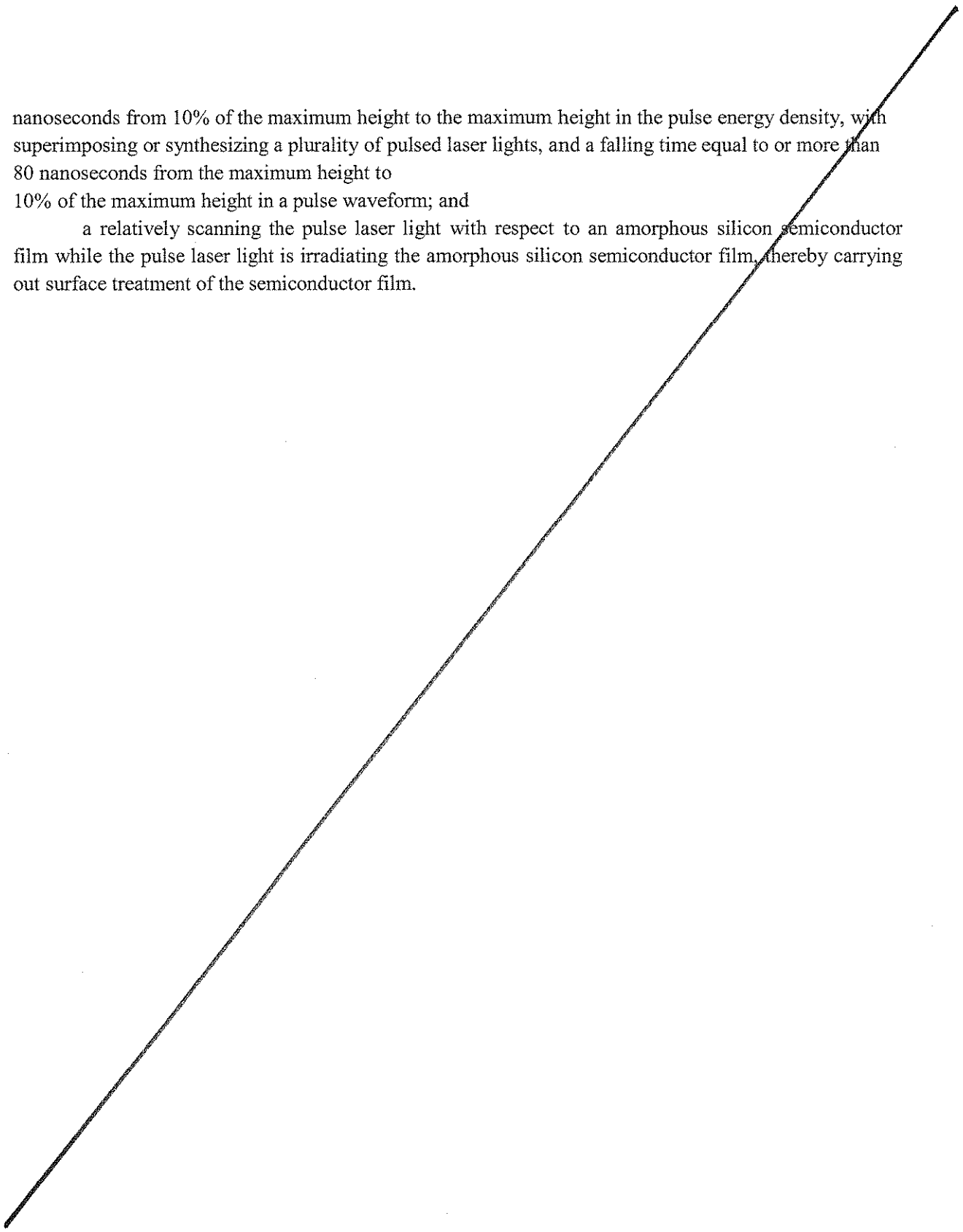
4. The laser annealing treatment apparatus according to claim 3, wherein the waveform shaping unit comprises beam splitting means that splits the pulse laser light output from the laser light source into a plurality of beams, delay means that delays each of the split beams, and beam synthesizing means that synthesizes the respective split beams.

5. The laser annealing treatment apparatus according to any one of claims 1 to 4 wherein the pulse laser light is excimer laser.

6. A laser annealing treatment method comprising: obtaining pulse laser light which presents a rising time equal to or less than 30

nanoseconds from 10% of the maximum height to the maximum height in the pulse energy density, with superimposing or synthesizing a plurality of pulsed laser lights, and a falling time equal to or more than 80 nanoseconds from the maximum height to
10% of the maximum height in a pulse waveform; and

a relatively scanning the pulse laser light with respect to an amorphous silicon semiconductor film while the pulse laser light is irradiating the amorphous silicon semiconductor film, thereby carrying out surface treatment of the semiconductor film.



WHAT IS CLAIMED IS:

1. A laser annealing treatment apparatus to crystallize an amorphous silicon semiconductor film by irradiating a pulsed laser light to the amorphous silicon semiconductor film with relatively scanning the pulse laser light with respect to the amorphous silicon semiconductor film, the laser annealing treatment apparatus comprising:

a laser light source that outputs pulse laser light;

an optical system that shapes the pulse laser light, and leads the shaped pulse laser light to a semiconductor film subject to treatment; and

a stage to be set the semiconductor film to be irradiated by the pulse laser light, wherein the pulse laser light irradiating the semiconductor film, which the pulse laser light is obtained by superimposing or synthesizing a plurality of pulsed laser lights, presents a rising time equal to or less than 30 nanoseconds from 10% of the maximum height to the maximum height in the pulse energy density, and a falling time equal to or more than 85 nanoseconds from the maximum height to 10% of the maximum height so as to obtain crystals having a crystal grain diameter of equal to or more than 200 nanometers by irradiating the pulse laser light to the amorphous silicon semiconductor film.

2. The laser annealing treatment apparatus according to claim 1 or 2, comprising a waveform shaping unit that shapes the pulse laser light output from the laser light source into a pulse waveform having the rising time and the falling time.

3. The laser annealing treatment apparatus according to claim 2, wherein the waveform shaping unit comprises beam splitting means that splits the pulse laser light output from the laser light source into a plurality of beams, delay means that delays each of the split beams, and beam synthesizing means that synthesizes the respective split beams.

4. The laser annealing treatment apparatus according to any one of claims 1 to 3, wherein the pulse laser light is excimer laser.

5. A laser annealing treatment method comprising:

obtaining pulse laser light which presents a rising time equal to or less than 30 nanoseconds from 10% of the maximum height to the maximum height in the pulse

energy density, with superimposing or synthesizing a plurality of pulsed laser lights, and a falling time equal to or more than 85 nanoseconds from the maximum height to 10% of the maximum height in a pulse waveform; and

a relatively scanning the pulse laser light with respect to an amorphous silicon semiconductor film while the pulse laser light is irradiating the amorphous silicon semiconductor film, thereby carrying out crystallization surface treatment of the semiconductor film to obtain crystals having a crystal grain diameter of equal to or more than 200 nanometers.