energy density with which microcrystallization occurs to the non-single-crystal semiconductor film by irradiation of the pulse laser, and is suitable for crystallization by irradiation of a plurality of times N being set as E0,

a first step of irradiating a plurality of times N1 (N1<N) with the pulse laser having an irradiation pulse energy density E1 which is the same as the irradiation pulse energy density E0; and

a second step of irradiating after the first step, a plurality of times N2 with the pulse laser having an irradiation pulse energy E2 which is lower than the irradiation pulse energy density E1, and is equal to or higher than an irradiation energy density that is necessary for a crystal to be remelted,

wherein the total number of times of irradiation to the same irradiation surface in the first step and the second step (N1 + N2) is equal to or larger than N times.

According to the second aspect of the present invention, a manufacturing apparatus of a crystal semiconductor is provided. The manufacturing apparatus comprises

one or two or more laser light sources that outputs or output a pulse laser;

an optical system that shapes the pulse laser and guides the pulse laser to a non-single-crystal semiconductor;

an energy regulating section that regulates an irradiation energy density of the pulse laser;

Claims

[Claim 1]

A manufacturing method of a crystal semiconductor film that performs crystallization by applying overlap irradiation while causing a pulse laser to scan relatively in a short axis direction, onto a non-single-crystal semiconductor film, comprising:

with an irradiation pulse energy density which is lower than an irradiation pulse energy density with which microcrystallization occurs to the non-single-crystal semiconductor film by irradiation of the pulse laser, and is suitable for crystallization by irradiation of a plurality of times N being set as E0,

a first step of irradiating a plurality of times N1 (N1<N) with the pulse laser having an irradiation pulse energy density E1 which is the same as the irradiation pulse energy density E0; and

a second step of irradiating, after the first step, a plurality of times N2 with the pulse laser having an irradiation pulse energy E2 which is lower than the irradiation pulse energy density E1, and is equal to or higher than an irradiation energy density that is necessary for a crystal to be remelted,

wherein the total number of times of irradiation to the same irradiation surface in the first step and the second step (N1+N2) is equal to or larger than N times.

[Claim 2]