CLAIMS

1. A flat substrate heating apparatus, comprising:

a module support plate having a plurality of unit module regions placed on an upper surface thereof;

a plurality of VCSEL modules having a plurality of laser light source devices and seated on unit module regions of the module support plate, respectively;

a power supply board placed below the module support plate and configured to supply power to the VCSEL module; and

an electrode terminal electrically connecting the VCSEL module and the power supply board while detachably securing them to upper and lower surfaces of the module support plate,

wherein the VCSEL module is formed of a VCSEL module comprising:

a device substrate having a device region and a terminal region, and having a device terminal hole penetrating the terminal region from an upper surface to a lower surface,

a VCSEL device arranged on the device region of the device substrate,

a terminal pad formed in a ring shape along an outer diameter of an upper end of the device terminal hole, and

a cooling block placed below the device substrate and having a block terminal hole,

wherein the module support plate comprises a support main body plate having a support terminal hole formed at a position, corresponding to the device terminal hole, of the unit module region,

the power supply board has a power terminal hole formed at a position corresponding to the support terminal hole, and

the electrode terminal comprises an upper terminal bolt passing through the device terminal hole and the block terminal hole to be inserted into an upper portion of the support terminal hole, a lower terminal bolt passing through the power terminal hole to be inserted

into a lower portion of the support terminal hole, and a connecting nut placed inside the support terminal hole and screw-coupled with the upper terminal bolt and the lower terminal bolt.

2. The flat substrate heating apparatus of claim 1, wherein the upper terminal bolt is electrically connected to the terminal pad, and the lower terminal bolt is electrically connected to the power supply board.

3. The flat substrate heating apparatus of claim 1, wherein the electrode terminal further comprises an insulating tube placed between an inner circumferential surface of the support terminal hole and an outer circumferential surface of the connecting nut.

4. The flat substrate heating apparatus of claim 1, wherein

the support main body plate has a support coolant hole formed by penetrating the support main body plate from an upper surface to a lower surface thereof,

the module support plate further comprises a support lower protrusion formed from a lower portion of the support coolant hole to a lower portion of the support main body plate and having a protrusion coolant hole being in communication with the support coolant hole,

the cooling block further comprises a block cooling flow passage connected to the support coolant hole, and

coolant for cooling the VCSEL device flows through the protrusion coolant hole, the support coolant hole and the block cooling flow passage.

5. The flat substrate heating apparatus of claim 4, wherein

the flat substrate heating apparatus further comprises a coolant supply module coupled to the support lower protrusion to supply coolant to the protrusion coolant hole,

the coolant supply module comprises a coolant supply main body having a planar shape corresponding to the module support plate, a coolant inflow pipe for supplying coolant to the coolant supply main body, and a coolant outflow pipe for outflowing coolant from the

coolant supply main body,

the coolant supply main body comprises at least one pair of main body internal flow passages extended therein in a direction in which the VCSEL module is arranged, at least one pair of main body upper flow passages formed by penetrating the coolant supply main body from the main body internal flow passage to an upper surface of the coolant supply main body and connected to the protrusion coolant hole, and one pair of main body lower flow passage formed by penetrating the coolant supply main body from the main body internal flow passage to a lower surface of the coolant supply main body, and

the coolant inflow pipe and the coolant outflow pipe are coupled to one pair of main body lower flow passages, respectively.

6. The flat substrate heating apparatus of claim 5, wherein the coolant supply main body is formed to be divided into a plurality of unit supply main bodies, and each unit supply main body comprises the main body internal flow passage, the main body upper flow passage and the main body lower flow passage.

7. The flat substrate heating apparatus of claim 5, wherein the coolant supply main body further comprises a main body connecting flow passage connecting the main body internal flow passages when the main body internal flow passage is formed in a plurality of pairs.