CLAIMS

1. A flat-substrate heating apparatus, comprising:

a module supporting plate having a plurality of unit module regions formed on an upper surface thereof;

a plurality of VCSEL modules, each VCSEL module having a VCSEL device and seated on the respective unit module region of the module support plate;

an electric power supplying board placed below the module support plate and configured to supply electric power to each VCSEL module; and

an electrode terminal electrically connecting each VCSEL module and the electric power supplying board while detachably securing them to upper and lower surfaces of the module support plate;

wherein the module support plate comprises a coolant supplying unit formed therein and configured to supply coolant to each VCSEL module; and

wherein each VCSEL module comprises:

a device substrate having a device region, a terminal region, and a device terminal hole passing through the terminal region from an upper surface to a lower surface of the terminal region;

a respective VCSEL device arranged on the device region of the device substrate;

a terminal pad formed in a ring shape extending along an outer periphery 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 further includes a support main body plate having a

support terminal hole formed at a position corresponding to the device terminal hole in the unit module region;

wherein the coolant supplying unit comprises

a main body internal flow passage formed to extend horizontally in a x-axial direction or a y-axial direction within the support main body plate;

a main body upper flow passage extending vertically within the support main body plate, a lower end of which being connected to the main body internal flow passage and an upper end of which being opened to an upper surface of the support main body plate; and

a main body lower flow passage extending vertically within the support main body plate, an upper end of which being connected to the main body internal flow passage, and a lower end of which being opened to a lower surface of the support main body plate, and

wherein the cooling block further comprises a block cooling flow passage being in communication with the main body upper flow passage, and is formed such that coolant for cooling each VCSEL device flows through the main body upper flow passage and the block cooling flow passage.

2. The flat-substrate heating apparatus of claim 1, wherein the electric power supplying board has an electric 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 electric 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 to be screw-coupled with the upper terminal bolt and the lower terminal bolt.

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

4. The flat-substrate heating apparatus of claim 2, 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.

5. The flat-substrate heating apparatus of claim 1, wherein the coolant supplying unit further comprises a coolant inlet tube for supplying coolant to the main body lower flow passage, and a coolant outlet tube for discharging coolant from the main body lower flow passage.

6. The flat-substrate heating apparatus of claim 5, wherein the support main body plate further comprises a connecting flow passage connecting the main body internal flow passages when the plurality of main body internal flow passages are formed in plurality of pairs.