What is claimed is:

1. A heat exchanger for regulating a temperature of a polishing surface of a polishing pad, comprising:

a flow passage structure having a heating flow passage and a cooling flow passage formed therein; and

a water-repellent material covering a side surface of the flow passage structure, a side surface of the heat exchanger being constituted by the water-repellent material,

wherein the flow passage structure has an exposed bottom surface constituting a bottom surface of the heat exchanger, and the flow passage structure is made of a material having a higher wear resistance and a higher thermal conductivity than those of the water-repellent material.

2. The heat exchanger according to claim 1, wherein the water-repellent material comprises a coating layer made of polytetrafluoroethylene.

3. The heat exchanger according to claim 1, wherein the water-repellent material comprises a water-repellent adhesive tape.

4. The heat exchanger according to claim 1, wherein the water-repellent material comprises a silicone rubber.

5. The heat exchanger according to claim 1, wherein the water-repellent material comprises a silicone rubber and a water-repellent coating layer, the water-repellent coating layer covering an outer surface of the silicone rubber.

6. The heat exchanger according to claim 1, wherein the material of the flow passage structure is ceramic.

7. The heat exchanger according to claim 1, wherein the material of the flow passage structure is SiC.

8. A polishing apparatus comprising:

a polishing table for supporting a polishing pad;

a polishing head configured to press a substrate against a polishing surface of the polishing pad;

a liquid supply nozzle configured to supply slurry or pure water selectively onto the polishing surface of the polishing pad; and

a heat exchanger configured to regulate a temperature of the polishing surface by performing heat exchange with the polishing pad, the heat exchanger including:

a flow passage structure having a heating flow passage and a cooling flow passage formed therein; and

a water-repellent material covering a side surface of the flow passage structure, a side surface of the heat exchanger being constituted by the water-repellent material,

wherein the flow passage structure has an exposed bottom surface constituting a bottom surface of the heat exchanger, and the flow passage structure is made of a material having a higher wear resistance and a higher thermal conductivity than those of the water-repellent material.

9. The polishing apparatus according to claim 8, wherein the material of the flow passage structure is ceramic.

10. The polishing apparatus according to claim 8, wherein the material of the flow passage structure is SiC.

11. A polishing method comprising:

pressing a substrate against a polishing surface of a polishing pad while supplying slurry onto the polishing surface, thereby polishing the substrate;

during polishing of the substrate, performing heat exchange between the polishing pad and heating and cooling liquids flowing in a heat exchanger in the presence of the slurry between the polishing surface of the polishing pad and a bottom surface of the heat exchanger;

after polishing of the substrate, performing a water polishing process in which pure water is supplied onto the polishing surface of the polishing pad while the substrate is brought into contact with the pure water on the polishing pad; and

during the water polishing process, bringing the bottom surface of the heat exchanger into contact with the pure water on the polishing surface of the polishing pad, thereby washing away the slurry from the bottom surface of the heat exchanger,

wherein the heat exchanger includes:

a flow passage structure having a heating flow passage and a cooling flow passage formed therein; and

a water-repellent material covering a side surface of the flow passage structure, a side surface of the heat exchanger being constituted by the water-repellent material,

wherein the flow passage structure has an exposed bottom surface constituting the bottom surface of the heat exchanger, and the flow passage structure is made of a material having a higher wear resistance and a higher thermal conductivity than those of the water-repellent material.

12. The polishing method according to claim 11, wherein the material of the flow passage structure is ceramic.

13. The polishing method according to claim 11, wherein the material of the flow

passage structure is SiC.

14. A polishing method comprising:

pressing a substrate against a polishing surface of a polishing pad while supplying slurry onto the polishing surface, thereby polishing the substrate;

during polishing of the substrate, performing heat exchange between the polishing pad and heating and cooling liquids flowing in a heat exchanger in the presence of the slurry between the polishing surface of the polishing pad and a bottom surface of the heat exchanger;

after polishing of the substrate, performing a water polishing process in which pure water is supplied onto the polishing surface of the polishing pad while the substrate is brought into contact with the pure water on the polishing pad;

during the water polishing process, bringing the bottom surface of the heat exchanger into contact with the pure water on the polishing surface of the polishing pad, thereby washing away the slurry from the bottom surface of the heat exchanger; and

spraying pure water onto a side surface of the heat exchanger after the water polishing process,

wherein the heat exchanger includes:

a flow passage structure having a heating flow passage and a cooling flow passage formed therein; and

a water-repellent material covering a side surface of the flow passage structure, the side surface of the heat exchanger being constituted by the water-repellent material.

15. A polishing method comprising:

pressing a substrate against a polishing surface of a polishing pad while supplying slurry onto the polishing surface, thereby polishing the substrate;

during polishing of the substrate, performing heat exchange between the polishing

pad and heating and cooling liquids flowing in a heat exchanger in the presence of the slurry between the polishing surface of the polishing pad and a bottom surface of the heat exchanger;

after polishing of the substrate, performing a water polishing process in which pure water is supplied onto the polishing surface of the polishing pad while the substrate is brought into contact with the pure water on the polishing pad;

during the water polishing process, bringing the bottom surface of the heat exchanger into contact with the pure water on the polishing surface of the polishing pad, thereby washing away the slurry from the bottom surface of the heat exchanger;

after the water polishing process, raising the heat exchanger away from the polishing surface of the polishing pad; and then

spraying pure water onto the heat exchanger to clean the heat exchanger,

wherein the heat exchanger includes:

a flow passage structure having a heating flow passage and a cooling flow passage formed therein; and

a water-repellent material covering a side surface of the flow passage structure, a side surface of the heat exchanger being constituted by the water-repellent material.