CLAIMS

1. A method of accessing data storage provided using double-stranded nucleic acid molecules provided on a thermal control device comprising a plurality of sites and temperature control circuitry to independently control a temperature of each of the plurality of sites;

the method comprising:

controlling temperatures of the plurality of sites using the temperature control circuitry, to provide a different temperature at a target site compared to other sites of the plurality of sites; and

performing a read operation to read data from one or more selected double-stranded nucleic acid molecules at the target site or a write operation to form one or more new double-stranded nucleic acid molecules encoded with data at the target site, where the different temperatures at the target site and the other sites provide a greater probability of the read or write operation acting on the target site compared to the other sites.

2. The method of claim 1, in which the plurality of sites are at respective portions of a shared fluid well, without a physical barrier blocking fluid from passing between adjacent sites.

3. The method of any of claims 1 and 2, in which the read operation or the write operation comprises flowing fluid across at least two of the plurality of sites including the target site.

4. The method of any preceding claim, in which:

each double-stranded nucleic acid molecule includes at least a data portion and an address portion;

double-stranded nucleic acid molecules with different data portions but the same address portion are provided at different sites of the thermal control device; and

at a given site of the thermal control device the double-stranded nucleic acid molecules located at the given site which have different data portions also have different address portions.

5. The method of any preceding claim, in which when a read operation is performed, said controlling temperatures comprises setting the target site to a higher temperature than the other sites during at least part of the read operation, to provide a greater probability of the double-stranded nucleic acid molecules separating into single-stranded nucleic acid molecules at the target site than at the other sites.

6. The method of any preceding claim, in which each double-stranded nucleic acid molecule includes at least a data portion and an address portion, and the read operation comprises:

exposing separated single-stranded nucleic acid molecules to an amplification mixture comprising at least one primer for selectively amplifying a single-stranded nucleic acid molecule separated from a double-stranded nucleic acid molecule having an address portion at least partially matching a target address portion; and

sequencing amplified nucleic acid molecules amplified by the amplification mixture to identify at least the data portion of the amplified nucleic acid molecules.

7. The method of claim 6, in which each double-stranded nucleic acid molecule comprises first and second tag portions at opposite ends of the double-stranded nucleic acid molecule; and

at least one of the first and second tag portions is an address-specific tag portion which includes at least part of the address portion of the double-stranded nucleic acid molecule.

8. The method of claim 7, in which the amplification mixture comprises:

a first primer complementary to the first tag portion of a first strand of a double-stranded nucleic acid molecule having a target address portion; and

a second primer complementary to the second tag portion of a second strand of the double-stranded nucleic acid molecule having the target address portion.

9. The method of any of claims 7 and 8, in which one of the first and second tag portions is an address-independent tag portion which is the same for double-stranded nucleic acid molecules having different address portions at the same site.

10. The method of any of claims 7 and 8, in which both the first tag portion and the second tag portion are address-specific tag portions.

11. The method of any of claims 7 to 10, in which at least one of the first tag portion and the second tag portion is an address-specific tag portion comprising:

an address-dependent part comprising at least part of said address portion; and

an address-independent part which is the same for double-stranded nucleic acid molecules having different address portions at the same site.

12. The method of any of claims 6 to 11, in which the amplification mixture is applied to the plurality of sites to amplify the released single-stranded nucleic acid molecules locally on the thermal control device.

13. The method of claim 12, in which the amplification is performed by one of:

PCR, where said controlling temperatures comprises thermal cycling of the target site through repeated cycles of heating and cooling, while maintaining other sites at a temperature lower than a maximum temperature used in said thermal cycling; and.

an isothermal enzyme-based amplification method, where said controlling temperatures comprises setting the temperature of the target site to a temperature greater than or equal to an activation temperature of at least one amplification-dependent enzyme.

14. The method of any of claims 6 to 11, in which the amplification mixture is applied to the separated single-stranded nucleic acid molecules after removal of the separated single-stranded nucleic acid molecules from the thermal control device.

15. The method of any of claims 5 to 14, in which the read operation comprises restoring the double-stranded nucleic acid molecules which were separated into single-stranded nucleic acid molecules.

16. The method of claim 15, in which each double-stranded nucleic acid molecule comprises a bound strand which is bound to a surface at one of the plurality of sites, and a further strand which is bound to the bound strand; and

the restoring comprises applying a restoration mixture comprising a restoration primer for annealing with at least part of a tag portion at one end of the bound strand of each separated double-stranded nucleic acid molecule.

17. The method of claim 16, in which the tag portion includes an address-independent part which is the same for double-stranded nucleic acid molecules having different address portions at a given site, and the restoration primer is complementary to the address-independent part.

18. The method of any of claims 15 to 17, in which during the restoring, the target site is maintained at a lower temperature than other sites.

19. The method of any preceding claim, in which when a write operation is performed, the target site is maintained at a lower temperature than other sites, to provide a greater probability

of the new double-stranded nucleic acid molecules forming at the target site compared to other sites.

20. The method of any preceding claim, in which the write operation comprises:

providing tag fragments of single-stranded nucleic acid bound to a surface at the target site; and

supplying a write set of single-stranded nucleic acid molecules corresponding to the new double-stranded nucleic acid molecules, each of the write set of single-stranded nucleic acid molecules including a tag portion complementary to the tag fragments, said different temperature at the target site providing a greater probability of the write set of single-stranded nucleic acid molecules annealing to the tag fragments at the target site compared to other sites.

21. The method of claim 20, in which the write operation also comprises applying an extension mixture to extend each tag fragment with bases complementary to a remaining portion of the single-stranded nucleic acid molecule that annealed to that tag fragment, to form a corresponding double-stranded nucleic acid molecule.

22. The method of any of claims 20 and 21, in which the write set of single-stranded nucleic acid molecules is exposed to at least two sites of the thermal control device including the target site.

23. The method of any preceding claim, in which the thermal control device comprises a substrate, and the plurality of sites are disposed at respective locations on the substrate;

each site comprises at least one attachment surface for attaching single or double-stranded nucleic acid molecules; and

a total surface area of said at least one attachment surface at a given site is greater than an area of a projection of the given site onto the plane of the substrate.

24. The method of any preceding claim, in which the thermal control device comprises:

a plurality of active thermal regions disposed at respective locations on a substrate, each active thermal region comprising a heating element configured to apply a variable amount of heat to a corresponding one of the plurality of sites, and a thermal insulation layer disposed between the heating element and the substrate; and

one or more passive thermal regions disposed between the plurality of active thermal regions on the substrate, each passive thermal region comprising a thermal conduction layer configured to conduct heat to the substrate;

in which the thermal conduction layer of said one or more passive thermal regions has a lower thermal resistance in a direction perpendicular to a plane of the substrate than the thermal insulation layer of said plurality of active thermal regions.

25. A computer-readable program or data structure comprising instructions or control data for controlling an apparatus to perform the method of any preceding claim.