

CLAIMS

What is claimed is:

- Claim 1. A system for performing a molecular analysis, the system comprising:
a reaction plate comprising a reaction plate RFID tag; and/or
a reagent container comprising a reagent container RFID tag; and
the reaction plate RFID tag and/or the reagent container RFID tag storing and/or sharing information for a workflow for the molecular analysis.
- Claim 2. The system of claim 1, wherein the molecular analysis is a polymerase chain reaction (PCR).
- Claim 3. The system of claim 1, wherein the PCR is selected from the group consisting of a qPCR, an epPCR, a RT-PCR, and a PLA involving PCR.
- Claim 4. The system of claim 1, wherein the reaction plate comprises at least one reaction site.
- Claim 5. The system of claim 4, wherein the reaction plate comprises a plurality of reaction sites.
- Claim 6. The system of claim 5, wherein each reaction site comprises a first reagent, wherein the first reagent is the same or different at different reaction sites.
- Claim 7. The system of claim 1, wherein the reagent container comprises a second reagent.
- Claim 8. The system of claim 1, wherein the reaction plate and/or the reagent container further comprise a temperature sensor wherein the temperature sensor is coupled to the reaction plate RFID and/or the reagent container RFID tag, the reaction plate RFID tag and/or the reagent container RFID tag each capable of storing a temperature history for the reaction plate and/or reagent container, respectively.
- Claim 9. The system of claim 1, wherein the reaction plate and/or the reagent container further comprise a light sensor wherein the light sensor is coupled to the reaction plate RFID and/or the reagent container RFID tag, the reaction plate RFID tag and/or the reagent container RFID tag

each capable of storing a light exposure history for the reaction plate and/or reagent container, respectively.

Claim 10. The system of claim 1, wherein the reaction plate and/or the reagent container further comprises a motion sensor wherein the motion sensor is coupled to the reaction plate RFID and/or the reagent container RFID tag, the reaction plate RFID tag and/or the reagent container RFID tag each capable of storing a motion detection history for the reaction plate and/or reagent container, respectively.

Claim 11. The system of claim 5, further comprising:
each reaction site comprising a first reagent; and
the reaction plate RFID tag comprising identifications of each reaction site and the corresponding first reagent contained by each reaction site.

Claim 12. The system of claim 6, wherein the first reagent comprises at least one primer and/or at least one probe.

Claim 13. The system of claim 12, wherein the at least one primer and/or the at least one probe in the first reagent of each reaction site is the same or different.

Claim 14. The system of claim 6, wherein the reagent container comprises a second reagent.

Claim 15. The system of claim 1, further comprising:
the reaction plate RFID tag encoding data regarding characteristics of the reaction plate;
and/or
the reagent container RFID tag encoding data regarding characteristics of the reagent container.

Claim 16. The system of claim 1, further comprising:
an instrument comprising an RFID reader operable to read the information for the workflow from the reaction plate RFID tag and/or the reagent container RFID tag.

Claim 17 The system of claim 16, wherein the instrument comprises logic operable to access a network server system and/or cloud network to download the information for a workflow for the molecular analysis, comprising an analysis protocol for the reaction plate; and/or wherein

the instrument comprises logic operable to provide a visual and/or verbal guide for the molecular analysis based on the information for the workflow.

Claim 18. The system of claim 17, the analysis protocol comprising an instruction for a liquid transfer to the reaction plate.

Claim 19. The system of claim 16, wherein the instrument further comprises an RFID writer and logic operable on the RFID writer to record a record on the reaction plate RFID tag of a liquid transfer to the reaction plate; and/or to record a record on the reagent container RFID tag of the liquid transfer from the reagent container.

Claim 20. The system of claim 19, the record comprising a reaction volume of the liquid transfer.

Claim 21. The system of claim 19, wherein the instrument further comprises logic operable on the RFID writer to record a reaction site of the reaction plate to which the liquid transfer is applied.

Claim 22. The system of claim 19, wherein the instrument further comprises logic operable on the RFID writer to record a date and/or time at which the liquid transfer is applied to the reaction plate and/or from the reagent container.

Claim 23. The system of claim 16, further comprising:

the instrument comprising logic operable to apply the information stored by the reaction plate RFID tag and the reagent container RFID tag to provide an instruction for mixing a first reagent on the reaction plate with a second reagent stored by the reagent container.

Claim 24. The system of claim 23, the instruction comprising the reaction site on the reaction plate comprising the first reagent, and a liquid transfer instruction for applying the second reagent to the reaction site.

Claim 25. The system of claim 24, the liquid transfer instruction comprising a reaction volume of the second reagent.

Claim 26. The system of claim 16, wherein the instrument comprises logic operable to read the reaction plate RFID tag and/or the reagent container RFID tag for an analysis protocol for the workflow.

Claim 27. The system of claim 26, the analysis protocol comprising a liquid transfer instruction for applying reagents to the reaction plate and/or from the reagent container.

Claim 28. The system of claim 1, the reaction plate RFID tag comprising an identification of a first reagent contained at a reaction site on the reaction plate.

Claim 29 The system of claim 12, the first reagent contained at the reaction site comprising at least one primer pair.

Claim 30. The system of claim 12, the first reagent contained at the reaction site comprising at least one probe, wherein the probe is optionally a 5' nuclease probe comprising a fluorophore moiety and a quencher moiety.

Claim 31. The system of claim 1, the reaction plate RFID tag comprising an identification of a next reaction plate in the workflow for the molecular analysis.

Claim 32. The system of claim 1, the reaction plate further comprising a temperature sensor coupled to the reaction plate RFID tag, the reaction plate RFID tag storing a temperature history for the reaction plate.

Claim 33. The system of claim 1, the reaction plate further comprising a light sensor coupled to the reaction plate RFID tag, the reaction plate RFID tag storing a light exposure history for the reaction plate.

Claim 34. The system of claim 6, wherein the first reagent is dry-spotted.

Claim 35. The system of claim 6, wherein the first reagent is pre-spotted.

Claim 36. A system for performing a molecular analysis, the system comprising:
a reaction plate comprising at least one reaction site containing a first reagent;
the reaction plate comprising a reaction plate RFID tag;
the reaction plate RFID tag encoding data regarding characteristics of the reaction plate;
an instrument comprising an RFID reader operable to read the reaction plate RFID tag to obtain the characteristics of the reaction plate; and
the instrument comprising logic operable to apply the characteristics of the reaction plate to interact with a second reagent in a workflow for the molecular analysis.

Claim 37. The system of claim 36, further comprising:

at least one reagent container comprising a second reagent and a reagent container RFID tag; and

the reagent container RFID tag encoding data regarding characteristics of the second reagent.

Claim 38. The system of claim 36, the reaction plate further comprising one or more selected from (i) a light sensor coupled to the reaction plate RFID tag, the reaction plate RFID tag storing a light exposure history for the reaction plate; (ii) a temperature sensor coupled to the reaction plate RFID tag, the reaction plate RFID tag storing a temperature history for the reaction plate; and (iii) a motion sensor coupled to the reaction plate RFID tag, the reaction plate RFID tag storing motion detection history for the reaction plate.

Claim 39. The system of claim 37, the reagent container(s) further comprising one or more selected from (i) a light sensor coupled to the reagent container(s) RFID tag(s), the reagent container(s) RFID tag(s) storing a light exposure history for the reagent container(s); (ii) a temperature sensor coupled to the reagent container(s) RFID tag(s), the reagent container(s) RFID tag(s) storing a temperature history for the reagent container(s); and (iii) a motion sensor coupled to the reagent container(s) RFID tag(s), the reagent container(s) RFID tag(s) storing motion detection history for the reagent container.

Claim 40. The system of claim 37, the characteristics of the second reagent comprising an expiration date for the second reagent.

Claim 41. The system of claim 37, further comprising:

the instrument comprising logic operable to read the characteristics of the second reagent from the reagent container RFID tag; and

the instrument comprising logic operable to apply the characteristics of the second reagent and the characteristics of the reaction plate to provide an instruction for applying the second reagent to the first reagent in the workflow for the molecular analysis.

Claim 42. The system of claim 41, the instruction identifying the reaction site comprising the first reagent on the reaction plate, and/or an instruction for transfer of the second reagent to the reaction site.

Claim 43. The system of claim 42, the transfer instruction comprising a reaction volume of the second reagent.

Claim 44. The system of claim 36, the characteristics of the reaction plate comprising an identification of the first reagent at the reaction site.

Claim 45. The system of claim 36, the first reagent comprising at least one primer pair.

Claim 46. The system of claim 36, the first reagent comprising at least one probe.

Claim 47. The system of claim 36, wherein the characteristics of the reaction plate identify each of the reaction sites and a corresponding first reagent contained by each of the reaction sites.

Claim 48. The system of claim 36, wherein the first reagent of each of the reaction sites is a dry-spotted reagent.

Claim 49. The system of claim 36, wherein the characteristics of the reaction plate comprise an identification of a next reaction plate in the workflow for the molecular analysis.

Claim 50. The system of claim 37, the instrument comprising an RFID writer and logic operable on the RFID writer to record a record on the reaction plate RFID tag of a liquid transfer of the second reagent to the reaction plate.

Claim 51. The system of claim 50, the record comprising a reaction volume of the second reagent applied to the reaction plate.

Claim 52. The system of claim 50, the instrument comprising logic operable on the RFID writer to record an identification of the second reagent and a discrete reaction site of the reaction plate to which the second reagent is applied.

Claim 53. The system of claim 50, the instrument comprising logic operable on the RFID writer to record a date and/or time at which the second reagent is applied to the reaction plate.

Claim 54. The system of claim 36, the instrument further comprising logic operable to access a network server system to download the workflow for the molecular analysis, the workflow comprising an analysis protocol for the reaction plate.

Claim 55. The system of claim 54, the analysis protocol comprising an instruction for a liquid transfer of the second reagent to the reaction plate.

Claim 56. The system of claim 36, the instrument further comprising logic operable to read the characteristics of the reaction plate for a protocol from the reaction plate.

Claim 57. The system of claim 56, the protocol comprising an instruction for a liquid transfer of the second reagent to the reaction plate.

Claim 58. A method for performing a molecular analysis, the method comprising:
reading a reaction plate RFID tag on a reaction plate; and/or
reading a reagent container RFID tag on a reagent container; and
applying information read from the reaction plate RFID tag and/or the reagent container RFID tag to carry out a workflow for the molecular analysis.

Claim 59. The method of claim 58, further comprising:
reading identifications of a first reagent and a reaction site for the first reagent from the reaction plate RFID tag.

Claim 60. The method of claim 58, further comprising:
reading an identification of a second reagent from the reagent container RFID tag.

Claim 61. The method of claim 58, further comprising:
reading from the reaction plate RFID tag a temperature history for the reaction plate, a light exposure history for the reaction plate, and/or a motion detection history for the reaction plate.

Claim 62. The method of claim 58, further comprising:
reading from the reagent container RFID tag a temperature history for the reagent container, a light exposure history for the reagent container, and/or a motion detection history for the reagent container.

Claim 63. The method of claim 58, further comprising:
reading from the reaction plate RFID tag identifications of a plurality of reaction sites on the reaction plate and a corresponding first reagent for each of the reaction sites.

Claim 64. The method of claim 58, further comprising:

reading from the reagent container RFID tag an expiration date for a second reagent stored by the reagent container.

Claim 65. The method of claim 60, further comprising:

reading from the reaction plate RFID tag data regarding characteristics of the reaction plate; and/or

reading from the reagent container RFID tag data regarding characteristics of the second reagent.

Claim 66. The method of claim 58, further comprising:

reading information for the workflow from the reaction plate RFID tag and/or the reagent container RFID tag; and/or

providing a visual and/or verbal guide for the workflow based on the information.

Claim 67. The method of claim 58, further comprising:

downloading the workflow for the molecular analysis from a network server system, the workflow comprising an analysis protocol for the reaction plate.

Claim 68. The method of claim 67, the analysis protocol comprising an instruction for liquid reagent, and/or sample transfer of one or more reagents to the reaction plate.

Claim 69. The method of claim 58, further comprising:

operating an RFID writer to record a record on the reaction plate RFID tag of a liquid, reagent, and/or sample transfer to the reaction plate.

Claim 70. The method of claim 69, the record comprising a reaction volume of the liquid transfer.

Claim 71. The method of claim 69, further comprising:

operating the RFID writer to record an identification of a reaction site of the reaction plate to which the liquid reagent, and/or sample transfer is applied.

Claim 72. The method of claim 69, further comprising:

operating the RFID writer to record a date and/or time at which the liquid, reagent, and/or sample transfer is applied to the reaction plate.

Claim 73. The method of claim 59, further comprising:

applying the information stored by the reaction plate RFID tag and the reagent container RFID tag to an instruction for mixing a first reagent with a second reagent in the workflow for the molecular analysis.

Claim 74. The method of claim 68, the instruction comprising a reaction site on the reaction plate comprising the first reagent, and an instruction for a liquid reagent, and/or sample transfer of the second reagent to the reaction site.

Claim 75. The method of claim 74, the instruction comprising a reaction volume of the second reagent.

Claim 76. The method of claim 58, further comprising:

reading the reaction plate RFID tag for an analysis protocol for the workflow.

Claim 77. The method of claim 76, the analysis protocol comprising an instruction for a liquid transfer of one or more reagents to the reaction plate.

Claim 78. The method of claim 58, further comprising:

reading the reaction plate RFID tag for an identification of a reagent contained at a reaction site on the reaction plate.

Claim 79. The method of claim 78, further comprising:

reading the reaction plate RFID tag for an identification of at least one primer pair.

Claim 80. The method of claim 78, further comprising:

reading the reaction plate RFID tag for an identification of at least one probe.

Claim 81. The method of claim 58, further comprising:

reading the reaction plate RFID tag for an identification of a next reaction plate in the workflow for the molecular analysis.

Claim 82. The method of claim 59, further comprising:

writing information about the reaction plate, the reagent container, the first reagent, the second reagent, and/or the molecular analysis to the reaction plate RFID tag and/or the reagent container RFID tag(s).

Claim 83. A smart consumable for performing a molecular analysis workflow, the smart consumable comprising at least one of:

a reaction holder comprising a reaction holder RFID tag, wherein the reaction holder RFID tag sends and receives and/or stores information regarding a workflow for the molecular analysis; and/or

a reagent container comprising a reagent container RFID tag, wherein the reagent container RFID tag sends and receives and/or stores information regarding the workflow for the molecular analysis.

Claim 84. The smart consumable of claim 83, wherein the reaction holder comprises a plurality of reaction sites, wherein one or more reaction sites of the plurality comprises a first reagent, wherein the first reagent is the same or different at different reaction sites on the same reaction holder.

Claim 85. The smart consumable of claim 84, wherein the reaction holder RFID tag comprises identifications of each reaction site and the corresponding first reagent for each reaction site.

Claim 86. The smart consumable of claim 84, wherein the first reagent is dry-spotted.

Claim 87. The smart consumable of claim 83, wherein the reaction holder RFID tag stores data regarding characteristics of the reaction holder and/or the reagent container RFID tag stores data regarding characteristics of a reagent in the reagent container.

Claim 88. The smart consumable of claim 83, wherein the reaction holder RFID tag and/or the reagent container RFID tag stores information to provide a visual and/or verbal guide for the workflow.

Claim 89. The smart consumable of claim 83, wherein the reaction holder RFID tag stores a record of a reagent to be applied to the reaction holder.

Claim 90. The smart consumable of claim 89, wherein the record comprising a reaction volume of the reagent to be applied to the reaction holder.

Claim 91. The smart consumable of claim 89, wherein the record comprising an identification of the reaction site of the reaction holder to which the reagent is applied.

Claim 92. The smart consumable of claim 89, wherein the record comprising a date and/or time at which the reagent is applied to the reaction holder.

Claim 93. The smart consumable of claim 89, wherein the record comprising an interaction of a first reagent with a second reagent in the workflow for the molecular analysis.

Claim 94. The smart consumable of claim 93, wherein the interaction comprising a discrete reaction site on the reaction holder comprising the first reagent, and an instruction for a liquid transfer of the second reagent to the discrete reaction site.

Claim 95. The smart consumable of claim 94, wherein the liquid transfer instructions comprising a reaction volume of the second reagent.

Claim 96. The smart consumable of claim 83, wherein the reaction holder RFID tag and/or the reagent container RFID tag store an analysis protocol for the workflow.

Claim 97. The smart consumable of claim 96, wherein the analysis protocol comprising an instruction for a liquid transfer of one or more reagents to the reaction holder.

Claim 98. The smart consumable of claim 83, wherein the reaction holder RFID tag store an identification of a reagent contained at a reaction site on the reaction holder.

Claim 99. The smart consumable of claim 98, wherein the reagent contained at the reaction site comprises at least one primer pair.

Claim 100. The smart consumable of claim 98, wherein the reagent contained at the reaction site comprises at least one probe.

Claim 101. The smart consumable of claim 83, wherein the reaction holder RFID tag and/or the reagent container RFID tag stores an identification of a next reaction holder and/or reagent container to be used in the workflow for the molecular analysis.

Claim 102. The smart consumable of claim 83, wherein the reaction holder further comprises a temperature sensor coupled to the reaction holder RFID tag, wherein the reaction holder RFID tag stores a temperature history for the reaction holder; a light sensor coupled to the reaction holder RFID tag, wherein the reaction holder RFID tag stores a light exposure history for the

reaction holder; and/or a motion sensor coupled to the reaction holder RFID tag, wherein the reaction holder RFID tag stores a motion detection history for the reagent container.

Claim 103. The smart consumable of claim 83, wherein the reagent container further comprises a temperature sensor coupled to the reagent container RFID tag, wherein the reagent container RFID tag stores a temperature history for the reagent container; a light sensor coupled to the reagent container RFID tag, wherein the reagent container RFID tag stores a light exposure history for the reagent container; and/or a motion sensor coupled to the reagent container RFID tag, wherein the reagent container RFID tag stores a motion detection history for the reaction holder

Claim 104. The smart consumable of claim 180, wherein the smart consumable further comprises a barcode.

Claim 105. The smart consumable of claim 87, wherein data regarding characteristics of the reaction holder and/or the reagent container comprises one or more of the following:

- an ID number;
- an expiration date;
- a part number;
- a barcode;
- a lot number;
- a part type;
- a storage temperature and/or storage temperature range;
- a reagent concentration;
- a recommended reagent concentration and/or volume to use in the workflow;
- a provision for liquid transfer support;
- a sales order number;
- a reagent name;
- an assay name;
- an assay location for a reagent to be used on the reaction holder;
- an assay ID;
- a suggested or required protocol for the molecular analysis;
- a sample name;
- a master mix name;

- an internet link or address (url);
- a reaction and/or a reagent volume;
- a test sample name;
- an analysis setting for the molecular analysis;
- a sample type;
- a molecular analysis type; and
- an instrument run protocol.

Claim 106. The smart consumable of claim 87, wherein data regarding characteristics of the reaction holder and/or the reagent container comprises can be rewritten to the reaction holder RFID tag and/or the reagent container RFID tag.

Claim 107. The smart consumable of claim 102, wherein the temperature sensor, the light sensor, and or the motion sensor is directly or indirectly coupled to the reaction holder RFID tag.

Claim 108. The smart consumable of claim 103, wherein the temperature sensor, the light sensor, and or the motion sensor is directly or indirectly coupled to the reagent container RFID tag.

Claim 109. The smart consumable of claim 83, wherein the reaction holder RFID tag and/or the reagent container RFID tag has a capacity to store at least 8 kilobytes of information.

Claim 110. The smart consumable of claim 84, wherein the plurality of reaction sites comprises at least 96 reaction sites, at least 384 reaction sites, at least 1536 reaction sites, at least 3072 reaction sites, or at least 12,288 reaction sites.