

CLAIMS

1. A method for operating and monitoring the cleaning of a sample processing instrument, comprising steps, performed by a control device, of:

directing a first sample through a flow cell in the sample processing instrument, wherein the first sample comprises first particles;

processing the first sample;

cleaning the flow cell of the sample processing instrument with a cleaning agent;

measuring a carryover amount in the flow cell after the cleaning, wherein the carryover amount comprises a measurement associated with an amount of the first particles remaining in a measurement region of the flow cell;

comparing the measured carryover amount against a predetermined target value that is input by a user, wherein the target value corresponds to a value indicative of a cleaning requirement; and

determining, based on the comparison, whether the cleaning requirement is met.

2. The method according to claim 1, further comprising:

repeating the cleaning step when it is determined that the cleaning requirement is not met; and

stopping a cleaning process when it is determined that the cleaning requirement has been met or when the number of cleaning reaches a maximum threshold.

3. The method according to claim 1, wherein the cleaning step comprises:

selecting a cleaning agent from a plurality of cleaning agents configured to clean the flow cell.

4. The method according to claim 3, wherein at least one of the cleaning agents comprises a sheath liquid.

5. The method according to claim 1, wherein the measuring step comprises:

5 pumping the monitoring solution through the flow cell;

 directing an optical beam toward the flow cell; and

 measuring light scattered from within the flow cell, wherein the measured light corresponds to the carryover amount in the flow cell.

10 6. The method according to claim 5, wherein the monitoring solution is different from the cleaning agent.

15 7. The method according to claim 5, wherein the carryover amount comprises a count of the first particles, a carryover rate of the first particles, or a concentration of the first particles within the flow cell.

8. The method according to claim 7, wherein the carryover amount is measured at predetermined intervals during the monitoring period.

20 9. The method according to claim 5, further comprising calculating, by the control device, based on the measured carryover amount, a concentration of carryover particles in the monitoring solution and/or a ratio of the carryover amount after cleaning to an amount of the first particles in a sample before cleaning.

25 10. The method according to claim 7, further comprising calculating a ratio of the carryover amount after the cleaning to an amount of the first particles detected in the first sample, or a ratio

of a concentration of the first particles measured after cleaning to a concentration of the first particles in the first sample.

11. The method according to claim 1, further comprising:

5 directing a second sample through the sample processing instrument following the determination that the cleaning requirement is met; and
processing the second sample.

12. The method according to claim 11, wherein the second sample is directed through the
10 sample processing instrument automatically by the control device in response to the determination that the cleaning requirement is met.

13. The method according to claim 1, wherein the first particles comprise biological nanoparticles.

15

14. The method according to any one of claims 1 to 13, wherein the sample processing instrument is a flow cytometer, and wherein processing the first sample comprises determining one or more properties of the first particles in the first sample by directing an optical beam toward the flow cell and measuring light emitted or scattered from within the flow cell.

20

15. The method according to claim 1, further comprising providing a user interface for being operated by a user and displaying information to the user, wherein before the cleaning, an operation window is displayed on the user interface for a user to operate, and wherein the operation window comprises at least one of: options for selecting a process to be run, dialog
25 boxes for inputting parameters and/or target values associated with the selected option, and a selectable list of one or more applicable samples selectable by the user for setting cleaning standards for selected applicable samples.

16. The method according to claim 15, wherein, during the cleaning or the measuring, a status window is displayed on the user interface, and wherein a running status is displayed on the status window.

5 17. The method according to claim 15, wherein after the measuring, a result viewing window is displayed on the user interface, and wherein a running result is displayed on the result viewing window.

10 18. The method according to any one of claims 15 to 17, wherein the measured carryover amount is displayed in real time on the user interface.

19. A method for operating and monitoring the cleaning of a sample processing instrument, comprising, by a computing system associated with the sample processing instrument:

15 displaying, on a user interface, a menu comprising at least one next-activity element, wherein the next-activity element is an operation option that enables the user to interact with the sample processing instrument by: configuring the processing of samples and the cleaning of the sample processing instrument, or monitoring such processing or cleaning;

20 displaying, on the user interface, a parameter setting element in response to a user selection of the at least one next-activity element, wherein the parameter setting element is configured to receive a user input in order to set a target carryover amount in a flow cell of the sample processing instrument, wherein the user input specifies the target carryover amount;

 receiving the user input at the parameter setting element;

 receiving carryover data corresponding to a measurement of particles present in a monitoring solution within the flow cell;

25 deriving an actual carryover amount according to the received carryover data; and

 displaying, on the user interface, one or more monitoring elements representing the measured carryover data, the actual carryover amount and/or the target carryover amount.

20. The method according to claim 19, further comprising:

determining a cleaning level by comparing the actual carryover amount with the target carryover amount; and

displaying, on the user interface, the cleaning level,

5 wherein the cleaning level comprises a first level indicating that a cleaning requirement is met and a second level indicating that the cleaning requirement is not met.

21. The method according to claim 20, further comprising:

10 when the second level is determined, repeating a cleaning cycle and then performing a monitoring process until maximum cleaning cycles are reached,

wherein receiving the user input comprises inputting parameters associated with the cleaning cycle and the monitoring process at the parameter setting element, and wherein the parameters comprise the maximum cleaning cycles.

15 22. The method according to claim 21, further comprising:

displaying, on the user interface, status of the cleaning cycle and the monitoring process.

20 23. The method according to claim 22, wherein the status of the cleaning cycle and the monitoring process comprises running process of the cleaning cycle, the number of the cleaning cycle which is performing, and running process of the monitoring process.

24. The method according to claim 19, wherein the monitoring elements comprise a graph showing the measured carryover data, wherein the graph comprises a histogram, a scatter dot plot, a density plot, a pseudocolor plot, or a contour plot.

25

25. The method according to claim 24, wherein the graph shows carryover signal intensity vs carryover count.

5 26. The method according to claim 19, wherein the parameter setting element is further configured to receive one or more user inputs setting cleaning standards for particular samples to be processed by the sample processing instrument.

27. The method according to claim 19, wherein the parameter setting element comprises a dialog box, a text field, a slider element, a dropdown list, and/or a radio button.

10

28. The method according to claim 19, further comprising:

displaying, on the user interface, a setting-applicable-sample element in response to a user selection of the at least one next-activity element, wherein the setting-applicable-sample element is configured to receive a further user input specifying one or more samples to which the target
15 carryover amount set at the parameter setting element is applied; and

receiving, at the setting-applicable-sample element, the further user input.

29. The method according to claim 19, wherein each of the actual carryover amount and the target carryover amount is showed in text or in a graph.

20

30. The method according to claim 19, wherein the actual carryover amount and the target carryover amount are showed in a same graph.

31. The method according to claim 19, further comprising:

25 storing monitoring results of each sample; and

displaying, on the user interface, historical monitoring results of the one or more samples in response to a user request for one or more samples by the at least one next-activity element.

5 32. The method according to claim 19, wherein the target carryover amount comprises at least one of a target carryover count, a target carryover rate, a target carryover concentration and a target percentage of carryover concentration; and

the actual carryover amount accordingly comprises at least one of an actual carryover count, an actual carryover rate, an actual carryover concentration and an actual percentage of carryover concentration.

10

33. The method according to claim 19, further comprising:

displaying, on the user interface, control elements for starting, stopping, interrupting, cancelling, repeating the method or a step of the method.

15 34. A system for operating and monitoring the cleaning of a sample processing instrument, comprising:

a fluid pipeline communicating fluid sources to a flow cell of the sample processing instrument;

a pump arranged in the fluid pipeline; and

20 a control device configured to:

direct a first sample through the flow cell in the sample processing instrument, wherein the first sample comprises first particles;

process the first sample;

25 control the pump to pump a cleaning agent through the fluid pipeline for cleaning the flow cell, and pump a monitoring solution through the fluid pipeline;

measure a carryover amount in the cleaned flow cell, wherein the carryover amount comprises a measurement associated with an amount of the first particles remaining in a measurement region of the flow cell;

5 compare the measured carryover amount against a predetermined target value that is input by a user, wherein the target value corresponds to a value indicative of a cleaning requirement; and

 determine, based on the comparison, whether the cleaning requirement is met.

10 35. The system according to claim 34, wherein the control device is further configured to: repeatedly clean the flow cell when it is determined that the cleaning requirement is not met; and stop a cleaning process when it is determined that the cleaning requirement has been met or when the number of cleaning reaches a maximum threshold.

15 36. The system according to claim 34, further comprising a switching device, wherein the switching device is configured to enable the pump to be in fluid communication selectively with a sample needle fitted in the flow cell or a sample source of the fluid sources.

20 37. The system according to claim 36, wherein the switching device comprises a three-way valve including a first port connected to the pump, a second port connected to the sample needle and a third port connected to the sample source, and wherein the three-way valve is switched between a first position allowing the pump to communicate with the sample needle and a second position allowing the pump to communicate with the sample source.

25 38. The system according to claim 37, wherein the pump is communicated with at least two cleaning agents.

 39. The system according to claim 38, wherein the at least two cleaning agents include sheath fluid.

40. The system according to claim 39, wherein the pump includes a first pump for pumping the sheath fluid and a second pump for selectively pumping the other cleaning agent and the monitoring solution.

5

41. A sample processing instrument comprising the system according to any one of claims 34 to 40.

10 42. A computer-readable medium on which a program is stored, wherein the program is executed by a processor of the control device to implement the method according to any one of claims 1 to 33.