

Claims

1. A modular reactor device having an outer housing, and a plurality of components contained within the outer housing, the components including:
 - 5 a reaction chamber;
 - a fluid pathway connected to the reaction chamber; and
 - a valve arranged to control flow of fluid within the device,wherein the outer housing has a plurality of connection ports providing connections from the exterior of the device to the interior, the connection ports including:
 - 10 a fluid input and a fluid output;
 - an electrical input; and
 - a pneumatic input;wherein either the electrical input or the pneumatic input is connected to the valve to provide for control of the valve, and
 - 15 either the fluid input or the fluid output is connected to the reaction chamber or the fluid pathway.
2. A modular reactor device according to claim 1 wherein the plurality of components further includes a storage compartment and a fluid pathway connecting the storage
 - 20 compartment and the reaction chamber.
3. A modular reactor device according to claim 1 or claim 2 wherein at least one of the components includes a reagent for a chemical or biological reaction.
- 25 4. A modular reactor device according to any one of the preceding claims wherein the plurality of connection ports also includes an optical input or output and/or a thermal input.
5. A modular reactor device according to any one of the preceding claims wherein the components include a plurality of valves which are arranged to control flow of fluid to/from
 - 30 the one reaction chamber; and/or along the fluid pathway.
6. A modular reactor device according to any one of the preceding claims wherein the components include a sensor.

7. A modular reactor device according to claim 6 wherein the plurality of connection ports includes a sensor output which is connected to the sensor to allow information from the sensor to be communicated externally to the device.
- 5 8. A kit including at least two modular reactor devices according to any one of the preceding claims, wherein the arrangement of the components contained within the outer housing is different in each of the modular reactor devices, and the arrangement of the connection ports is identical in each of the modular reactor devices.
- 10 9. A kit according to claim 8 wherein the outer housing of each of the modular reactor devices is identical in size and shape.
10. A base station arranged to engage with a least one modular reactor device and having:
a docking portion arranged to receive the modular reactor device;
15 a plurality of connectors arranged in a predetermined configuration to enable connection to a predetermined configuration of connection ports on the reactor device when the device is received in the docking portion, the connectors including:
a fluid output and a fluid supply;
an electrical connector; and
20 a pneumatic connector;
a processor arranged to control the supply of one or more of: fluid, electrical power or signals and pneumatic pressure or signals, so as to cause the reactor device to carry out a chemical or biological reaction within the reaction device.
- 25 11. A base station according to claim 10 wherein the connectors further include a thermal connector and the processor is arranged to control the supply of a heating or cooling medium to the reactor device.
12. A base station according to claim 10 or claim 11 wherein the connectors further
30 include an optical connector and the processor is arranged to control the supply of optical power or signals to the reactor device and/or to receive optical signals from the reactor device.

13. A base station according to any one of claims 10 to 12 wherein the processor is arranged to control the reaction carried out by the reactor device by supplying electrical power or signals, or pneumatic pressure or signals to the reactor device so as to cause the reactor device to repeatedly process small volumes of fluid through components in the reactor device.
14. A base station according to any one of claims 10 to 13 wherein the processor is arranged to control the reaction based on signals received from the modular reactor device.
15. A kit including at least one modular reactor device according to any one of claims 1 to 9 and a base station according to any one of claims 10 to 14.
16. A method of manufacturing a modular reactor device for performing a reaction to produce a chemical or biological product, the method including the steps of:
- 15 determining at least one reagent required for the performance of the reaction;
- selecting, from a limited range of predetermined components, components for inclusion in the modular reactor device and determining an arrangement of said selected components within the modular reactor device to enable the reaction to be performed;
- producing, by an additive manufacturing process, a modular reactor device having:
- 20 an outer housing having a plurality of ports in fixed positions through which fluid, electrical power or signals, and pneumatic pressure or signals, can be supplied to the modular reactor device;
- said selected components arranged within the outer housing in the determined arrangement and connected to each other and/or to one or more of the ports; and
- 25 said at least one reagent stored within at least one of the selected components.
17. A method according to claim 16 wherein said selected components include:
- a valve;
- a reactor chamber; and
- 30 a fluid pathway,
- and further wherein the determined arrangement includes:
- said fluid pathway connecting at least one of said plurality of ports to the reactor chamber; and

a port for supplying electrical power or signals, or a port for supplying pneumatic pressure or signals, being connected to said valve.

18. A method according to claim 16 or claim 17, wherein the outer housing further
5 includes ports through which heating or cooling medium, and optical power or signals can be supplied to the modular reactor device.

19. A method of manufacturing a modular reactor device for performing a reaction to
produce a chemical or biological product, the reaction requiring at least one reagent, the
10 method including the steps of:

receiving computer-coded instructions for the manufacture of the modular reactor
device;

producing a modular reactor device using an additive manufacturing process, the
additive manufacturing process being controlled by a processor which uses the received
15 computer-coded instructions for manufacture, the modular reactor device having:

an outer housing having a plurality of ports in fixed positions through which fluid,
electrical power or signals, and pneumatic pressure or signals can be supplied to the modular
reactor device;

said selected components arranged within the outer housing in the determined
20 arrangement and connected to each other and/or to one or more of the ports; and

said at least one reagent stored within at least one of the selected components.

20. A method of manufacturing a chemical or biological product, the method including
the steps of:

25 receiving a modular reactor device specifically designed to produce said chemical or
biological product and computer-coded instructions arranged to control the operation of said
reactor device;

connecting the received reactor device to a base station which is arranged to supply
fluid, electrical power or signals, and pneumatic pressure or signals to the reaction device
30 through a plurality of connectors which are arranged in a fixed arrangement to enable
connection to a predetermined configuration of connection ports on the reaction device; and

running the computer-coded instructions on a processor in said base station thereby
causing the base station to supply one or more of: fluid, electrical power or signals, and/or

pneumatic pressure or signals to the reactor device and thereby control the reactor to cause it to carry out steps to produce said chemical or biological product.

21. A method of manufacturing a chemical or biological product, the method including
5 the steps of:

receiving a modular reactor device specifically designed to produce said chemical or biological product and computer-coded instructions arranged to control the operation of said reactor device wherein the modular reactor device includes at least one sensor arranged to monitor a characteristic of a reagent or a reaction in the reactor device; and is designed to
10 allow performance of a plurality of alternative reaction pathways to produce a chemical or biological product,

running the computer-coded instructions on a processor in said modular reactor device thereby causing the modular reactor device to control one or more of: fluid flows, electrical power or signals, and/or pneumatic pressure or signals in the modular reactor
15 device and thereby cause the modular reactor device to carry out steps to produce said chemical or biological product;

receiving a signal from said sensor and selecting, based on the received signal, one of the alternative reaction pathways that is to be followed; and

controlling the modular reactor device accordingly to cause the modular reactor
20 device to follow the selected reaction pathway.

22. A method of manufacturing a chemical or biological product, the method including the steps of:

receiving a modular reactor device specifically designed to produce said chemical or
25 biological product and computer-coded instructions arranged to control the operation of said reactor device; and

running the computer-coded instructions on a processor in said modular reactor device thereby causing the modular reactor device to control one or more of: fluid flows, electrical power or signals, and/or pneumatic pressure or signals in the modular reactor
30 device and thereby cause the modular reactor device to carry out steps to produce said chemical or biological product,

wherein the computer-coded instructions are arranged to cause the processor to control the modular reactor device to perform a plurality of operations on a regular cycle, the

plurality of operations each causing predetermined quantities of fluids within the modular reactor device to be processed in different parts of the reactor at the same time.

23. A method of manufacturing a chemical or biological product, the method including
5 the steps of:
- receiving computer-coded instructions for the manufacture of a modular reactor device specifically designed to produce said chemical or biological product and computer-coded instructions arrange to control the operation of said reactor device;
 - 10 producing a modular reactor device using an additive manufacturing process, the additive manufacturing process being controlled by a processor which uses the received computer-coded instructions for manufacture;
 - connecting the manufactured reactor device to a base station which is arranged to supply fluid, electrical power or signals, and pneumatic pressure or signals, to the reaction device through a plurality of connectors which are arranged in a fixed arrangement to enable
15 connection to a predetermined configuration of connection ports on the reaction device; and
 - running the computer-coded instructions for control on a processor in said base station thereby causing the base station to supply one or more of: fluid, electrical power or signals, and/or pneumatic pressure or signals to the reactor device and thereby control the reactor to cause it to carry out steps to produce said chemical or biological product.
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24. A method of any one of claims 16 to 23 wherein the modular reactor device is a modular reactor device according to any one of claims 1 to 9.