CLAIMS

1. An intelligent system for gene synthesis and monoclonal picking, comprising:

a core operation module for performing operations associated with gene synthesis and monoclonal picking, the core operation module at least including:

a liquid operation compartment for performing operations of mixing gene fragments and operations of mixing synthetizing reagents with biological samples in the process of gene synthesis;

a purification compartment for performing purification operations on nucleic acid products created after the mixing;

an amplification compartment for performing amplification operations and error correction operations on fragments of the nucleic acid products and performing culturing and amplification operations on vectors; and

a monoclonal picking compartment for performing monoclonal picking operations on purified and cultured nucleic acid products; and

a control system for controlling at least a part of operations of corresponding compartments of the core operation module.

2. The intelligent system for gene synthesis and monoclonal picking according to claim 1, wherein the core operation module further comprises a loading and unloading compartment for replenishing various materials required in the process of gene synthesis and monoclonal picking ;

wherein the core operation module further comprises a transfer compartment for transferring biological samples and/or materials among at least a part of the liquid operation compartment, the purification compartment, the amplification compartment, the monoclonal picking compartment and the loading and unloading compartment, and wherein the transfer compartment

includes a transfer robot.

3. The intelligent system for gene synthesis and monoclonal picking according to claim 2, wherein the transfer compartment is arranged at a middle position of the core operation module, while the liquid operation compartment, the purification compartment, the amplification compartment, the monoclonal picking compartment and the loading and unloading compartment are divided into two groups and arranged at both sides of the transfer compartment; or

wherein the transfer compartment is arranged at a central position of the core operation module, while the liquid operation compartment, the purification compartment, the amplification compartment, the monoclonal picking compartment and the loading and unloading compartment are arranged around the transfer compartment along a circumference.

4. The intelligent system for gene synthesis and monoclonal picking according to claim 2, wherein at least a part of the liquid operation compartment, the purification compartment, the transfer compartment, the amplification compartment, the monoclonal picking compartment and the loading and unloading compartment are arranged in a compartment body capable of being closed tightly, the compartment body including a laminar flow unit to put corresponding compartments in a controlled laminar flow environment, wherein the laminar flow unit comprises a laminar air-supply unit including an air-supply fan or at least one filtering unit, and a laminar air-discharge unit including an air-discharge fan and a reverse filtering unit; and/or

wherein an ultraviolet irradiation unit is provided in the compartment body.

5. The intelligent system for gene synthesis and monoclonal picking according to claim 1, wherein the liquid operation compartment comprises at least one pipetting unit, the pipetting unit is mounted on a linear motor gantry main frame structure so as enable the pipetting unit to be movable along an X-

axis; and wherein each pipetting unit comprises one or more pipetting heads each of which is independently movable along a Y-axis and a Z-axis in the pipetting unit;

wherein each pipetting unit includes one or more movers mounted along a direction of the Y-axis to enable each pipetting head in each pipetting unit to be movable along the Y-axis under driving of the movers; and wherein each pipetting unit further comprises a Z-axis driving mechanism to drive each pipetting head in each pipetting unit to move along the Z-axis; and

wherein the liquid operation compartment further comprises one or more of a liquid pumping unit, a pump set array, a bottom-compartment liquid storage unit, a consumable stage sliding table array, an oscillation unit, a consumable carrier and an operation stage.

6. The intelligent system for gene synthesis and monoclonal picking according to claim 5, wherein the liquid operation compartment includes two or more pipetting units, which are configured to be able to perform operations independently of each other as well as to perform operations in parallel.

7. The intelligent system for gene synthesis and monoclonal picking according to claim 1, wherein the purification compartment comprises at least one purification pipetting unit, the at least one purification pipetting unit is mounted on a linear motor gantry main frame structure, so as to enable the at least one purification pipetting unit to be movable along an X-axis; and wherein each purification pipetting unit comprises one or more purification pipetting heads each of which is independently movable along a Y-axis and a Z-axis in the purification pipetting unit; and

wherein the purification compartment further comprises one or more of a liquid pumping unit, a consumable stage sliding table array, a bottom-compartment liquid storage unit, an oscillation unit, a consumable carrier, an

operation stage and a temperature-controlled storage device.

8. The intelligent system for gene synthesis and monoclonal picking according to claim 1, wherein the monoclonal picking compartment comprises a monoclonal picking unit for picking monoclonal nucleic acid products from an orifice plate;

wherein the monoclonal picking unit comprises a multi-channel pick head assembly formed by integrating a plurality of pick head elements;

wherein the multi-channel pick head assembly is connected to an integrated gas path on-off valve group, which is capable of controlling each pick head element separately to enable each pick head element to independently move and to independently fulfill operations of picking the monoclonal nucleic acid products; and

wherein the monoclonal picking unit is mounted on an X-Y linear motor gantry main frame structure, so as to enable the monoclonal picking unit to be movable along an X-axis and a Y-axis, and the monoclonal picking unit includes a Z-axis motor, so as to enable the monoclonal picking unit to be movable along a Z-axis.

9. The intelligent system for gene synthesis and monoclonal picking according to claim 8, wherein the monoclonal picking unit further comprises an image capturing assembly for identifying and localizing target nucleic acid products in the monoclonal picking process;

wherein the image capturing assembly includes: a camera for real-time determining positions of nucleic acid products to be picked; and an optical distance sensor for calibrating a vertical distance between tip ends of the pick head elements in the multi-channel pick head assembly and a surface of the orifice plate bearing the nucleic acid products to be picked, and for evaluating a

surface flatness of the orifice plate.

10. The intelligent system for gene synthesis and monoclonal picking according to claim 9, wherein the monoclonal picking unit further comprises a bracket assembly including vertical support plates and a plurality of horizontal support plates extending perpendicular to the vertical support plates, and wherein each horizontal support plate is provided with holes through which the plurality of pick head elements extend, so as to ensure accurate localization of the plurality of pick head elements;

wherein one of the plurality of horizontal support plates is also provided with a guiding and positioning mechanism for the plurality of pick head elements, so as to localize and guide vertical movement of the plurality of pick head elements in the multi-channel pick head assembly;

wherein an upper surface of a bottom horizontal support plate of the plurality of horizontal support plates is configured to function as a limiting surface for each pick head element in the multi-channel pick head assembly, in order to ensure that the tip ends of the plurality of pick head elements are at a same height.

11. The intelligent system for gene synthesis and monoclonal picking according to claim 10, wherein the optical distance sensor and/or the camera are also arranged on the upper surface of the bottom horizontal support plate.

12. The intelligent system for gene synthesis and monoclonal picking according to claim 8, wherein each pick head element includes a first section and a second section, both of which are configured to be in floating connection, wherein each pick head element includes a floating connection mechanism which includes a sleeve element and a floating element, the floating element is configured to be mountable in the sleeve element and capable of floating a distance within the sleeve element.

13. The intelligent system for gene synthesis and monoclonal picking according to claim 12, wherein an upper end of the first section of each pick head element is connected with a drive control valve to drive vertical movement of the pick head element by the drive control valve, and a lower end of the first section of each pick head element is secured within the sleeve element of the floating connection mechanism; and

wherein the lower end of the first section of each pick head element includes a threaded joint for threadedly connecting the lower end of the first section to the sleeve element of the floating connection mechanism.

14. The intelligent system for gene synthesis and monoclonal picking according to claim 12, wherein each pick head element further comprises a guide element arranged on an outer periphery of the second section of the pick head element;

wherein the guide element is configured as a guide bearing.

15. The intelligent system for gene synthesis and monoclonal picking according to claim 8, wherein each pick head element is made of SUS316 stainless steel material.

16. The intelligent system for gene synthesis and monoclonal picking according to claim 8, wherein the monoclonal picking compartment further comprises one or more of an oscillation-coating unit, a multi-channel pipetting unit, a liquid pumping unit, a bottom-compartment liquid storage unit, a consumable stage sliding table array, an operation stage and a temperature-controlled storage device;

wherein the oscillation-coating unit is used for realizing uniform distribution of flora on the orifice plate, and wherein the oscillation-coating unit comprises a clamping mechanism and a cam oscillating mechanism, the orifice

plate capable of being clamped in the clamping mechanism and oscillated together with the clamping mechanism under the drive of the cam oscillating mechanism.

17. The intelligent system for gene synthesis and monoclonal picking according to claim 8, wherein the monoclonal picking compartment further comprises a pick head cleaning assembly including at least one pick head cleaning element, for cleaning the multi-channel pick head assembly of the monoclonal picking unit;

wherein the pick head cleaning assembly further comprises a pick head drying unit including a heating unit, for drying the pick head elements in the multi-channel pick head assembly of the monoclonal picking unit.

18. The intelligent system for gene synthesis and monoclonal picking according to claim 17, wherein the pick head drying unit includes an air-supply duct and an air-discharge duct, for cooling the pick head elements in the multi-channel pick head assembly of the monoclonal picking unit that have been dried.

19. The intelligent system for gene synthesis and monoclonal picking according to claim 1, wherein the control system includes a control computer, an I/O data collecting module, and a drive module;

wherein the control system comprises a software system, which includes one or more of a workflow editing unit, a device monitoring and operating unit, a device debugging unit, a data storage unit, a log prompting unit and a parameter setting unit.

20. The intelligent system for gene synthesis and monoclonal picking according to claim 1, wherein the intelligent system for gene synthesis and monoclonal picking further comprises at least one of the following modules: a sequencer module for detecting, confirming and screening synthesized gene

fragments in the process of gene synthesis and monoclonal picking; and a material storage module for storing various materials required in the process of gene synthesis and monoclonal picking.