CLAIMS

1. A microfluidic device comprising a blood circuit with one or more cell culture compartments and a urine circuit comprising a filtration unit and a reabsorption unit, wherein both circuits are connected with each other via the filtration unit and the reabsorption unit, and further comprising a reservoir compartment in addition to the one or more cell culture compartments, which serves to add nutrient solution to the system.

2. The microfluidic device of claim 1, wherein the filtration unit comprises a filtration barrier that selectively allows the passage of molecules from the blood circuit to the urine circuit based on size and charge of the molecules.

3. The microfluidic device of claim 2, wherein the filtration barrier is a mechanical or biological barrier, preferably a biological barrier that comprises podocytes.

4. The microfluidic device of any one of claims 1-3, wherein the reabsorption unit comprises a barrier that allows reabsorption of fluid from the urine circuit to the blood circuit.

5. The microfluidic device of claim 4, wherein the reabsorption barrier is a biological barrier, preferably wherein the biological barrier comprises renal tubule cells.

6. The microfluidic device of any one of claims 1-5, wherein at least one of the cell culture compartments of the blood circuit comprises an organ equivalent mimicking liver function, and at least one of the cell culture compartments of the blood circuit comprises an organ equivalent mimicking intestine function.

7. Use of the microfluidic device of any one of claims 1-6 in analytical testing, diagnostics, research, target validation, toxicity studies, tissue engineering, tissue manufacturing, drug screening, and/or pharmacokinetic-pharmacodynamic analysis.

8. A method of operating a microphysiological system making use of the microfluidic device of any one of claims 1-6.

9. The method of claim 8, further comprising selectively adding a nutrient solution to the microphysiological system via the cell culture compartment comprising an organ equivalent or tissue comprising epithelial cells of the gastrointestinal tract and mimicking intestine function.

10. A method of detecting an analyte in a microphysiological system making use of the microfluidic device of any one of claims 1-6, wherein the method comprises adding a test sample to a cell culture compartment of the blood circuit, preferably wherein the cell culture compartment comprises a tissue comprising epithelial cells of the gastrointestinal tract, the skin, or the respiratory tract.

11. A method of mimicking homeostasis comprising operating a microphysiological system making use of the microfluidic device of any one of claims 1-6 comprising a blood circuit with one or more cell culture compartments and a urine circuit comprising a filtration unit and a reabsorption unit, wherein both circuits are connected with each other via the filtration unit and the reabsorption unit.

12. The method of claim 11, comprising selectively adding a nutrient solution to the microphysiological system via a cell culture compartment comprising epithelial cells of the gastrointestinal tract, the skin, or the respiratory tract, preferably wherein the epithelial cells are epithelial cells of the gastrointestinal tract, preferably of the small intestine.

13. A method of culturing and/or maintaining cells comprising seeding the microfluidic device of any one of claims 1-6 with cells.

14. A kit for operating a microphysiological system comprising the microfluidic device of any one of claims 1-6 and instructions for use.

15. An ADME (absorption, distribution, metabolism, excretion) assay, or an ADMET (absorption, distribution, metabolism, excretion, toxicity) assay, comprising the microfluidic device according to any one of claims 1-6.