

Respect the Pioneer

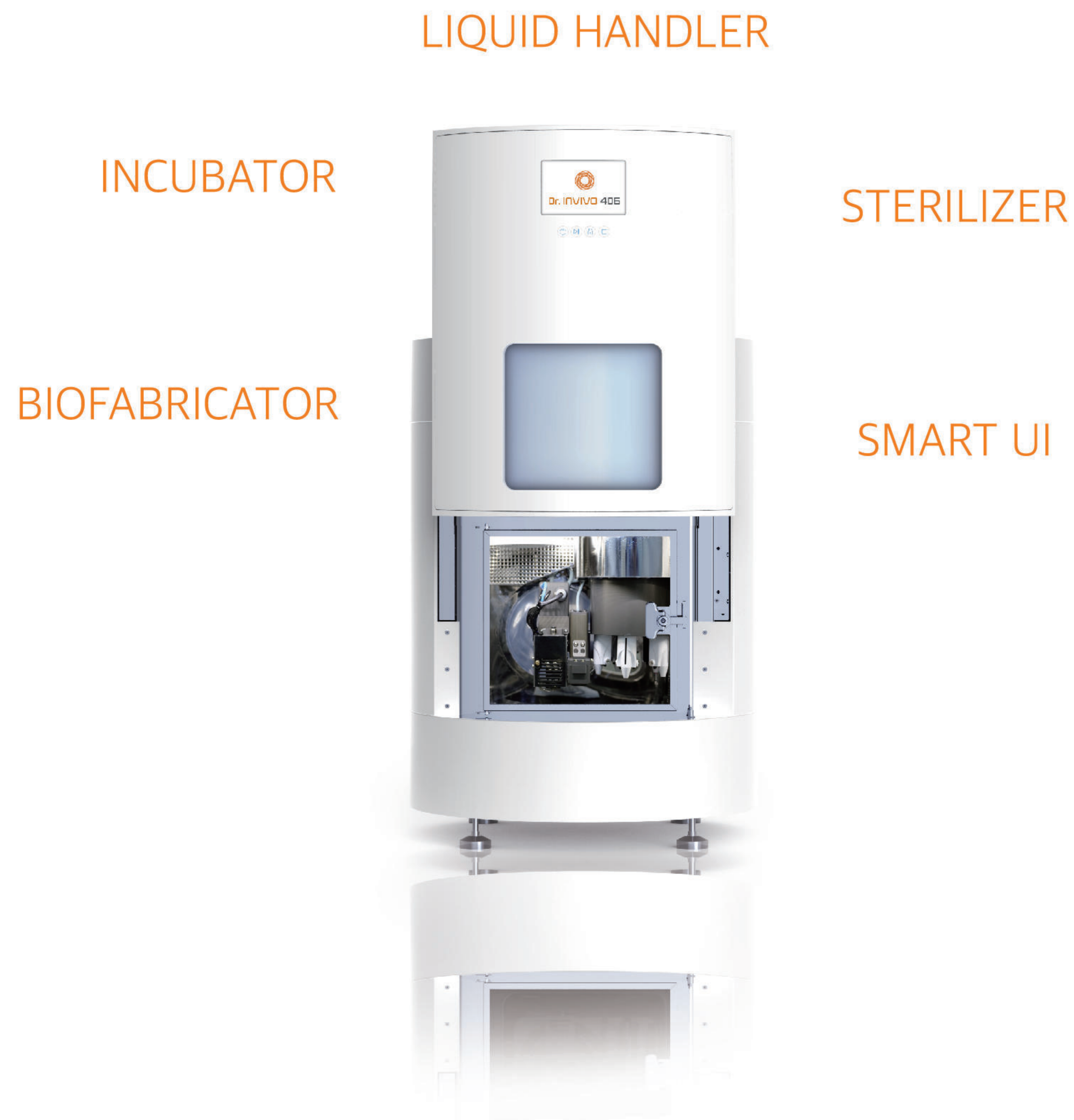


Organ Regenerator

Dr. INVIVO 406

NEXT-GENERATION BIOPRINTING

A next-generation bioprinting technology should be ready for the most complex challenges in human tissue fabrication and applications. Stepping up from simply laying cells out in a 3-dimensional space, Dr. INVIVO 4D6, with the built-in cell incubator and liquid handling functions, allows the researcher to meet the real needs of keeping cells functional while upgrading researchers' work to high-throughput usage.



EFFECTS OF VARIOUS PRINTING PARAMETERS ON CELL VIABILITY

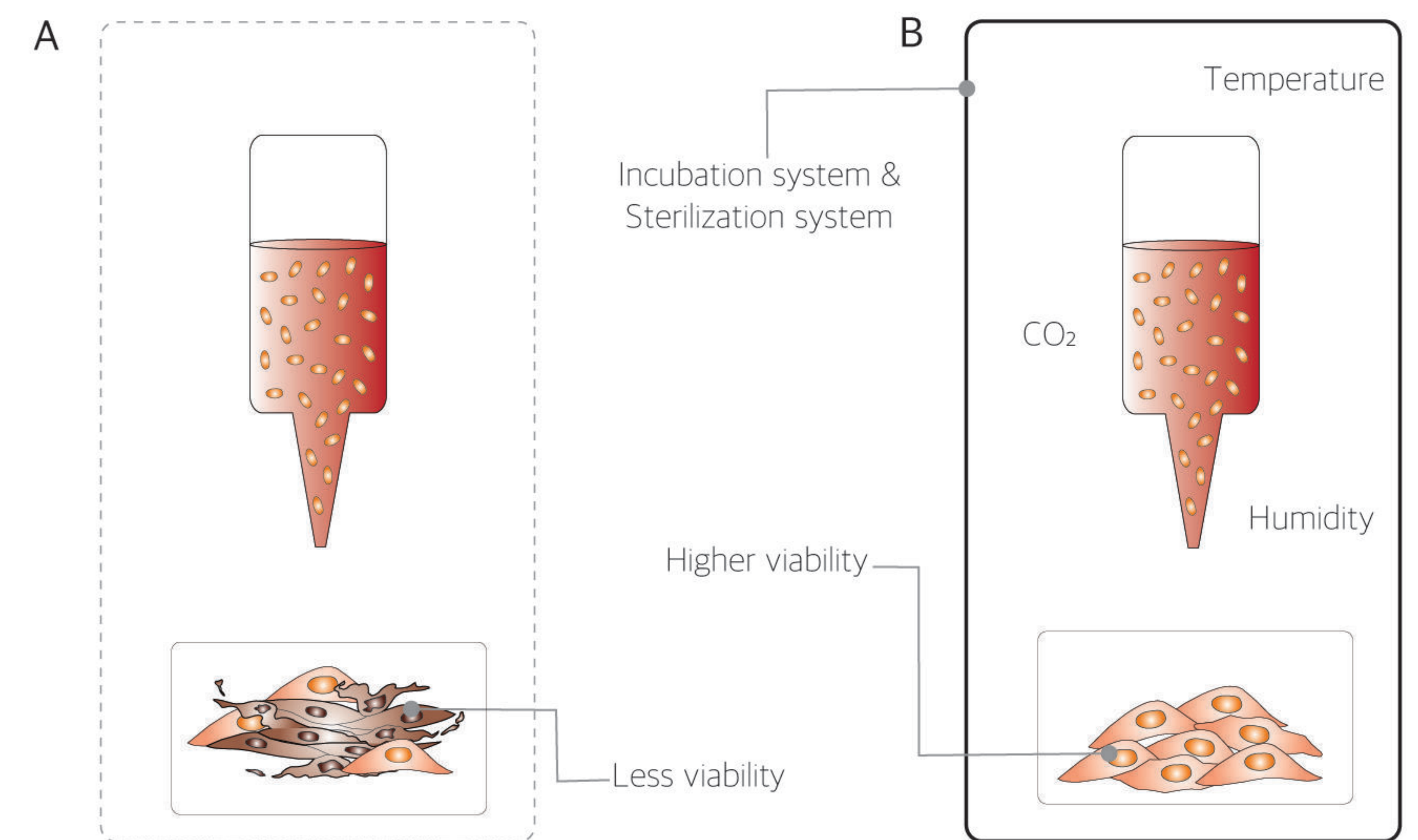


FIG.1. Effects of various printing parameters on cell viability. (A) Open Bio 3D printer. (B) Closed Dr. INVIVO 4D6.

Cell viability is affected by both mechanical and biological parameters of the printing process. While smaller nozzle diameters, higher dispensing pressure and higher bioink concentrations may lower cell viability, simulating the appropriate cellular environments inside the chamber can boost the result, i.e. temperature up to threshold 37°C, carbon dioxide level of 5% concentration similar to the environment in mammalian blood and tissues; 75-80% humidity level similar to the internal organs in the human body.

Reference:

[1] Panwar, A., & Tan, L. (2016). Current Status of Bioinks for Micro-Extrusion-Based 3D Bioprinting. *Molecules*, 21(6), 685.

IMPORTANT BIOLOGICAL PRINTING PARAMETERS

TEMPERATURE

Cellular functions are highly responsive to temperature which can also affect cell viability.

CO₂

CO₂ gas changes pH in the medium. In the improper pH conditions, cells stop growing and lose viability and it may produce morphological changes of cells.

HUMIDITY

Low humidity causes evaporation of water from the media. Evaporation leaves too-high concentrations of salts, minerals, etc., resulting in toxicity and cell death. [2]

STERILIZATION

Preventing contamination is the key to apply the printed tissue in vivo.

Replicating the temperature, CO₂ and humidity with in vivo conditions is important to replicate tissues and organs.

AVERAGE VIABILITY WITH AND WITHOUT ADDED HUMIDITY

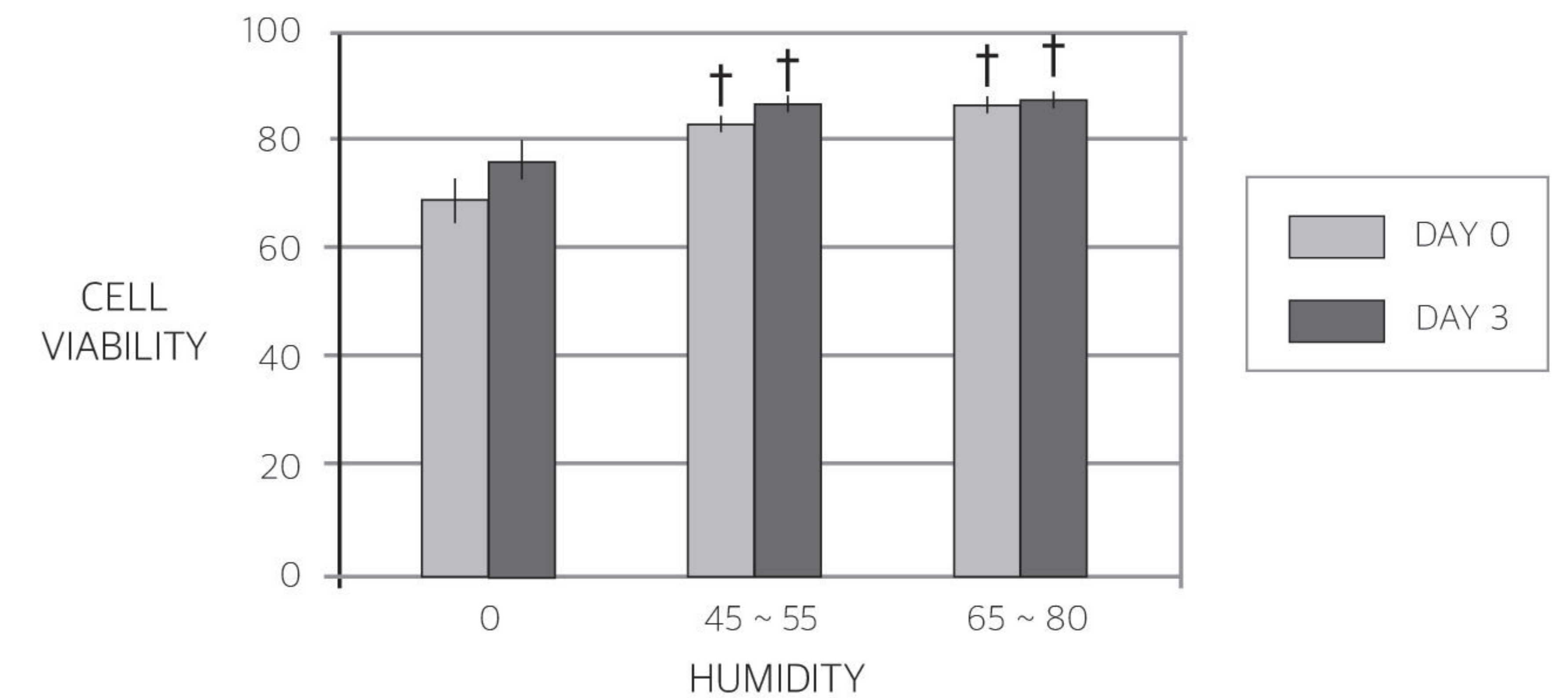
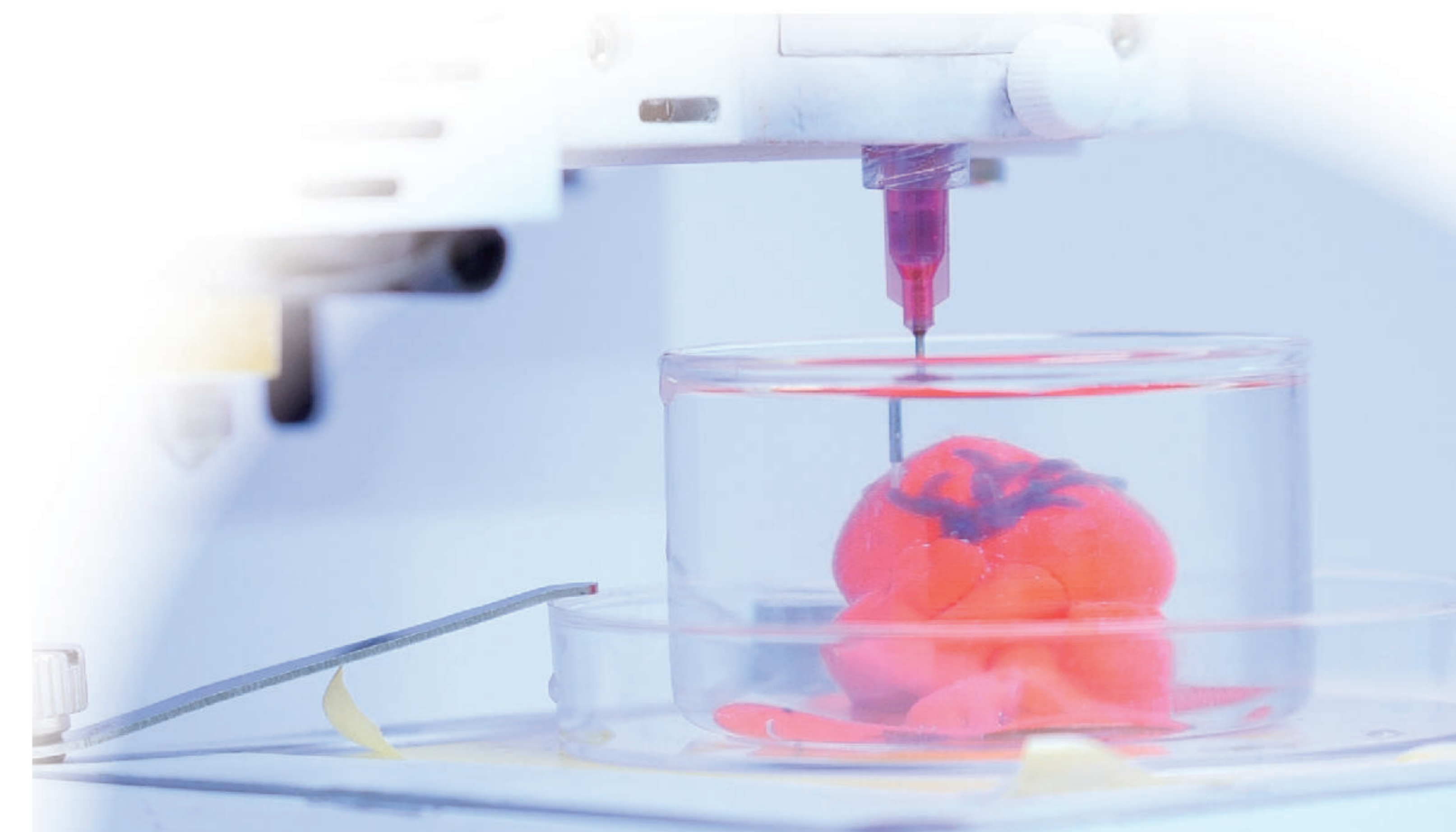


FIG.2. Average cell viability with and without added humidity. At day 0 and 3, the average viability of constructs generated with and without added humidity (45-55% using an evaporative humidifier or at 65-80% using an ultrasonic humidifier) is greater and the difference is sustained over the three days of time period.

Reference:

[2] Smith, C. M., Christian, J. J., Warren, W. L., & Williams, S. K. (2007). Characterizing Environmental Factors that Impact the Viability of Tissue-Engineered Constructs Fabricated by a Direct-Write Bioassembly Tool. *Tissue Engineering*, 13(2), 373-383.



REVOLUTIONARY APPLICATIONS

Key Function	Capability	Applications
Chamber Temperature Control (10 ~ 60 °C)	Fabricates with diverse types of hydrogels	<ul style="list-style-type: none"> * Below 10 °C : Collagen, Gelatin, Matrigel, Hyaluronic acid, Alginate, Silk * Between 10 °C - 30 °C: Pluronic, Fibrin, Chitosan, Cellulose, PEG * Above 30 °C: Poly-phosphazene, Agarose
Max 6 Modular Printheads	Fabricates complex tissue structures with six different cell types and/or materials	<ul style="list-style-type: none"> * Cardiac patch with vasculature (3 types of vascular cells, cardiac outer and inner wall muscles) * Lung tissue with air sacs (multi-level porous scaffold seeded with cells) * Organ-on-a-chip (3-D cell culture chip that simulates the activities, mechanics and physiological response of mini-organs) * Food printing (production of “future food” containing complex and customized formulations of nutrients, i.e. artificial meat, complex vitamins) * Pharmaceutical tablet printing (1 excipient material combined with 5 different types of drug formulations)
Sterile Chamber	Creates implantable devices in an environment compliant with medical device standards	In-hospital manufacturing of patient-customized tissues and regenerative patches with autologous solutions (i. e. skin regeneration for diabetic foot ulcer patients, cartilage regeneration, heart patch development, retina patch development)
Cell Incubator (Temperature/Humidity/CO ₂)	<ul style="list-style-type: none"> * Supports higher cell viability both during and after the printing process * Supports proper cell proliferation and differentiation in the printed tissue 	<ul style="list-style-type: none"> * Study of stemness maintenance and stem cell differentiation in a controlled 3-D culture environment * Incubator for genetically modified plant organisms (protoplast development into plants using various seeds in a 3-D agarose matrix)
Well-Plate Printing (up to 96 wells)	<ul style="list-style-type: none"> * Creates an assay composed of organoids that can be used for drug efficacy and toxicity testing * Allows for high-throughput media exchange using suction features 	<ul style="list-style-type: none"> * Safer development of vaccine assays using highly contagious and harmful forms of pathogens (i. e. HIV, Coronavirus) * Controlled dispensing of small volumes of mixed materials, i. e. PCR genotyping, drug formulation development, etc. in a CO₂ chamber
80X Built-In Scope	Allows for quality evaluation of scaffolds (i. e. pore size, morphology, surface)	<ul style="list-style-type: none"> * Creation of complex biological systems with surface modifications and pore sizes that mimic native tissues * Development of personalized medicines with precisely controlled pore sizes and different dissolution rates

DR. INVIVO PUBLICATIONS

Skin Tissue	Adipose Tissue	Cartilage Tissue	Salivary Gland Tissue
			
Cancer Modeling	Wound Healing	Medical Devices	Stem Cell Spheroids
			
Drug Testing	4D Printing (Polyurethane)	Nuclear Waste Management	Bioink Development
			

DR. INVIVO 4D6 AT A GLANCE

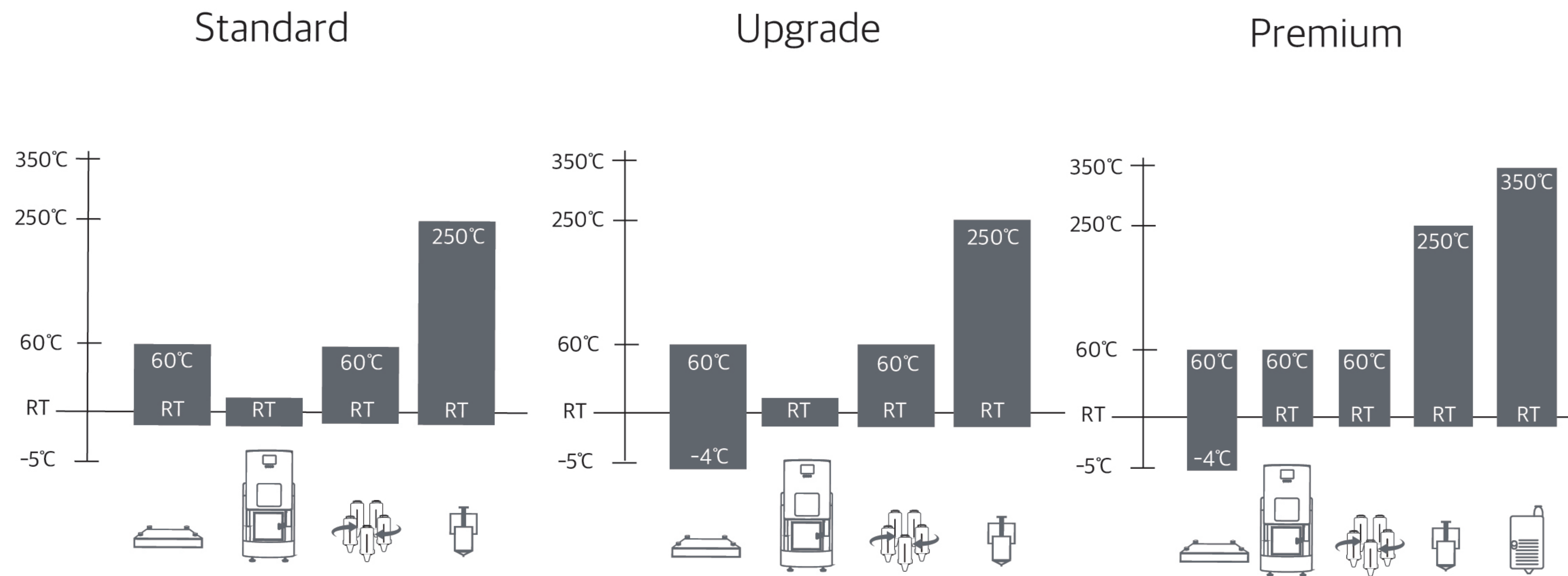
Category	Description	Standard	Upgrade	Premium
Dimension	Φ683 x 965 (H)			
Weight	~95 kg			
Print Speed	Max 50 mm/s			
Max Build Area	80 x 80 x 30 mm (R) 80 x 80 x 40 mm (L)			
Printhead Set 1	5-axis rotary syringe bio-dispenser (R)			
Printhead Set 2	1-axis interchangeable printhead (L)	Filament Extruder	Filament Extruder	Hot-Melt Pneumatic Dispenser Filament Extruder
Bed Temperature	Heating and cooling functions	Heating Only RT ~ 60 °C	Cooling and Heating -4 ~ 60 °C	Cooling and Heating -4 ~ 60 °C
Auto-Bed Leveling and Nozzle End-Alignment	Ultrasonic sensor, nozzle-end align sensor	✓	✓	✓
XYZ Motor Resolution	10 μm	✓	✓	✓
Monitoring Camera	Built-in monitoring camera (720p)	✓	✓	✓
Embedded Air Compressor	5 bar 3-layer filtering (5 μm, 0.5 μm, 0.01 μm), water separator	✓	✓	✓
Particle Control	Circular flow and HEPA filter (0.5 μm, 99.998%)	✓	✓	✓
Embedded Cooling	Coolant tank, Circulation pump, Manifold		✓	✓
Linear Robot	Medical-grade linear motion system		✓	✓
Incubator	Chamber CO ₂ level, temperature & humidity control			✓
External Air Compressor	Max 10 bar via HPA system (CO ₂) (Option)			✓
Chamber Cooling Unit	Cooling temperature 10 °C			✓
Optical Microscope	80X resolution (Built-In)			✓


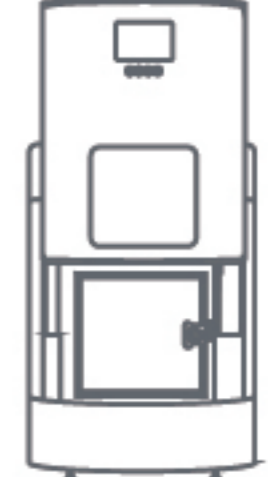



* The Specifications above are subject to change

EMPOWERING RESEARCH WITH VERSATILE PRINTHEADS AND CUSTOMIZABLE OPTIONS

* The Specifications above are subject to change

TEMPERATURE CONTROL RANGE



-  Printing Bed
-  Closed Chamber
-  Rotary Syringe Dispensers
-  Filament Extruder
-  Hot-melting Dispenser

OPTIONAL



Frozen Bed
(-15°C)



Low-Temperature
Plasma Sterilizer
(Coming Soon)

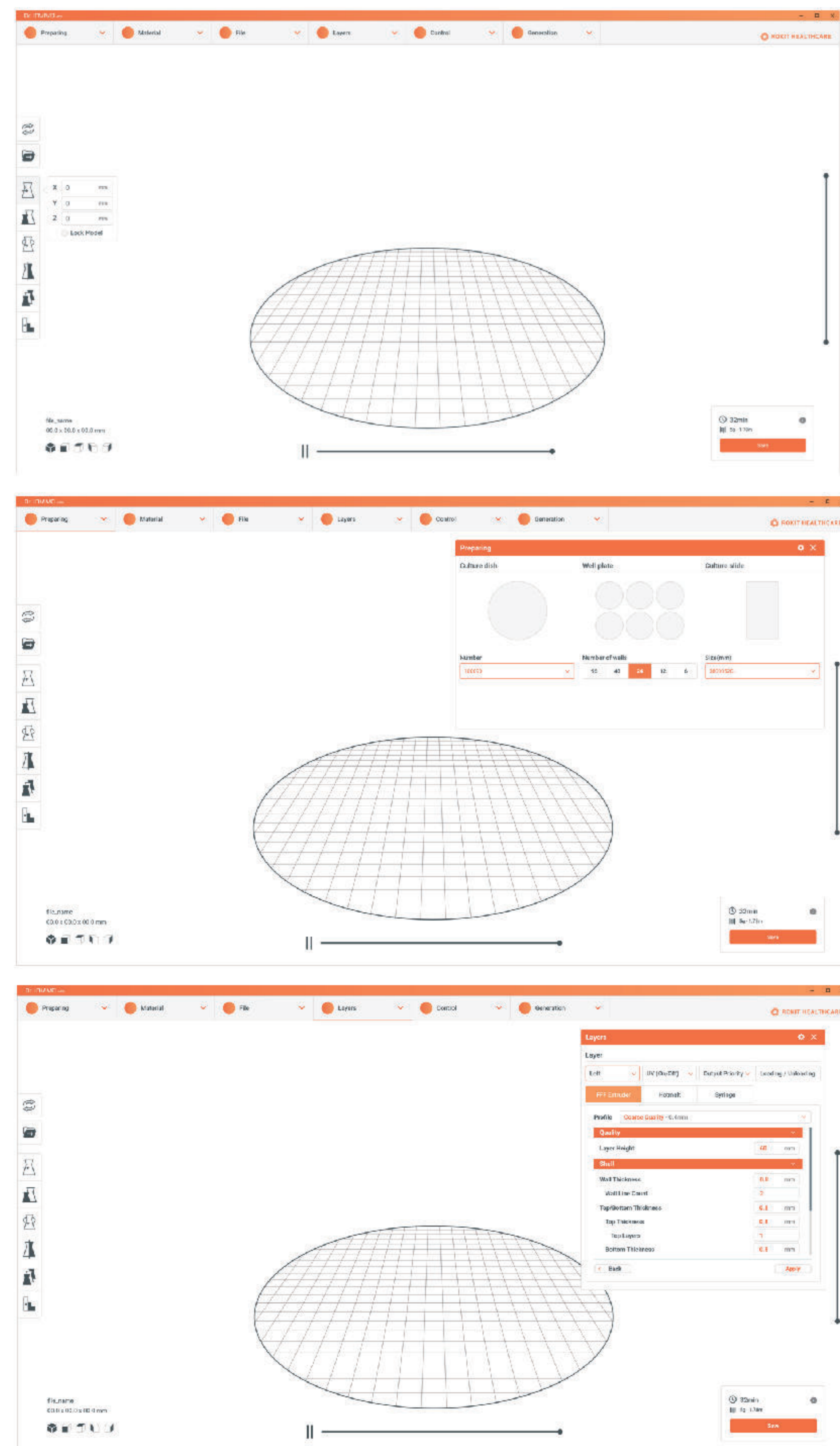


Co-Axial
Dispensing Syringe
(Coming Soon)

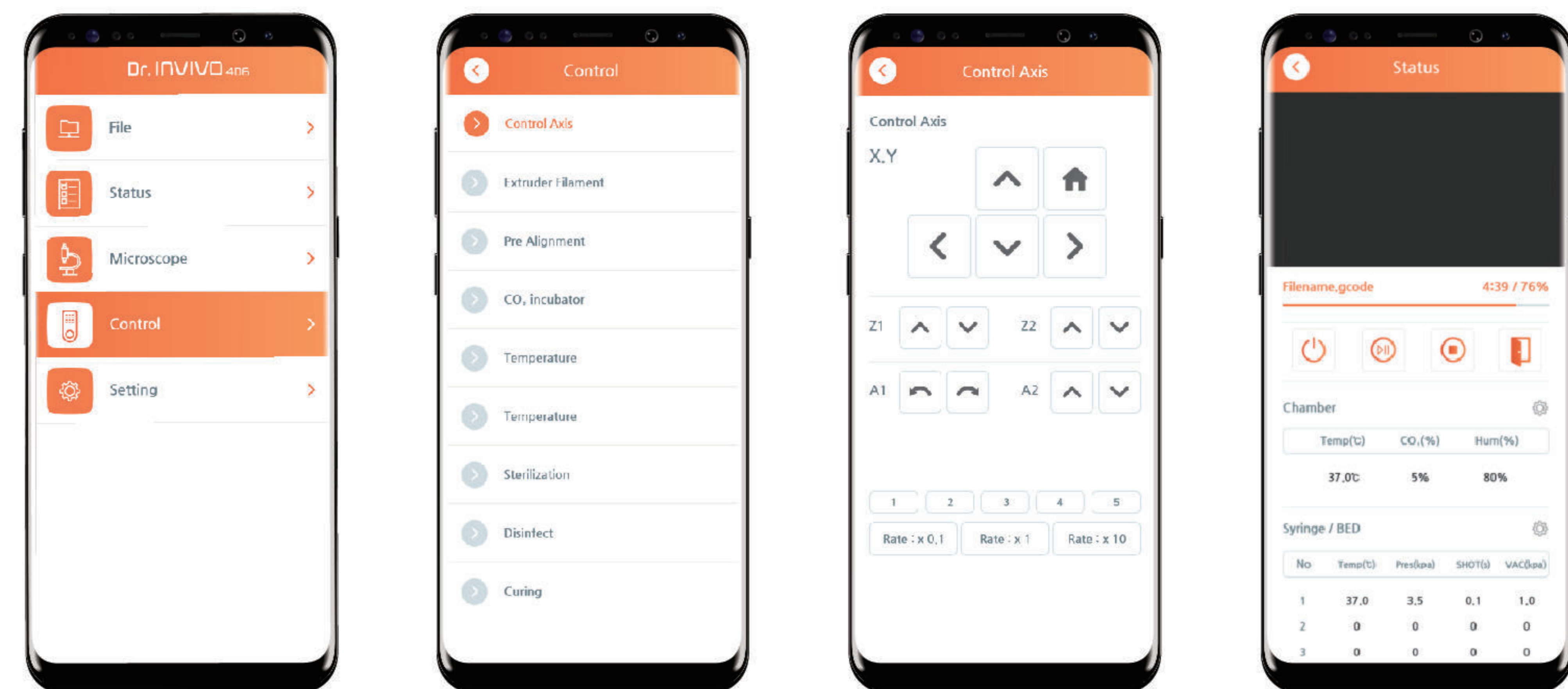
INTUITIVE, HUMAN-CENTERED SOFTWARE

Dr. INVIVO 4D6 is equipped with a state-of-the-art, user-centered operating system, designed to simplify the bioprinting workflow while maximizing the diversity of outputs from the printer. It can be controlled by both the built-in LCD touchscreen as well as the PC software, accessible by Wi-Fi, Ethernet, and USB cable connections. For the ease of mobility, the software is also provided as a first-of-its-kind mobile app, allowing you to operate Dr. INVIVO 4D6 in the palm of your hands.

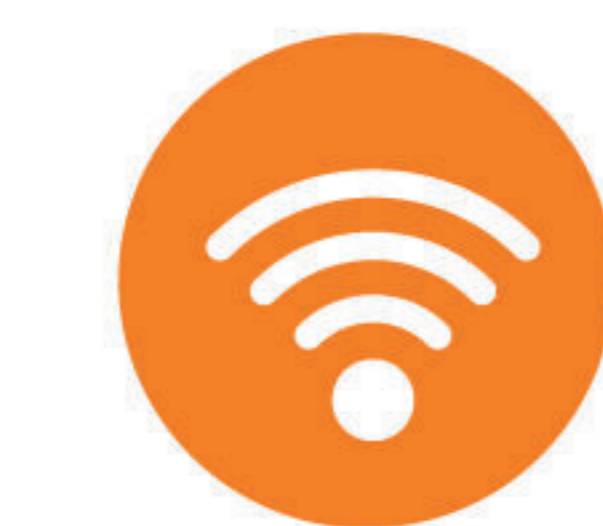
PC SOFTWARE



MOBILE APPLICATION (ANDROID)



CONNECTIONS



Direct Wi-Fi



Ethernet



USB Cable

