

Technical Specifications of the GeSiM BioScaffolder Bio-Printer

Basic Description

The BioScaffolder printer is a very versatile and flexible bio-printer which can be used for a wide range of printing applications for all current typical printing materials and offers future proofing for more complex printing and bioengineering research applications.

The BioScaffolder features four independent Z-drives and a host of accessories to suit the user needs. Three of the Z-axes exist for cartridges to print a variety of pasty materials (hydrogels and biopolymers e.g. collagen, alginate, bone cement paste, polymer paste etc.) and thermoplastics (e.g. PCL). For higher temperatures of up to 250°C, a piston-based metal extruder is available. What sets the BioScaffolder apart from other bio-printers is the unique piezoelectric ink-jet dispensing system for pico- and nano-litre spotting of cells, proteins and curing/hardening substances on certain coordinates within a scaffold structure.

Most work in this field is done with researchers mixing up the scaffold material and cells/proteins in order to grow tissues after printing the scaffold structure. In some cases this works but not all scaffold materials accept cells and keep them alive during the printing process. With the GeSiM approach these two steps can be separated to combine high mechanical stability of the (hardened) scaffold structure with a cell friendly environment for tissue growing. Since the cells/proteins are aspirated from a micro-well plate several different proteins/cells can be spotted in the same printing run without having to stop to change tips or cartridges. Other unique features which sets it apart from competitive bio-printers is the availability of a long and growing list of optional accessories and tools for complete bio-printing flexibility and to cover all future R&D requirements.

This includes the following:

- * CAD STL data import function.
- * Cooling/heating of microplates and target holders.
- * Melt electrospinning for the printing of tiny/small strut sized (10-20um) thermoplastic structures.
- * Printing heads can be added for dispensing larger droplet volumes e.g. solenoid valve dispensers (50nl droplet size) and highly viscous materials as droplets e.g. third party adhesive dispensers (PICOxMOD and DELO-DOT dosage heads).
- * Core shell for creating inner and outer structure/tube – combine hard and soft materials; print composed strands of different materials, e.g. a soft cell containing core material and a much harder shell material.
- * Dedicated UV lamp options on the dispensing head for polymer curing.
- * Cryo/Peltier cartridge chiller dispenser (4°C) available late 2017 – e.g. for dispensing hydrogels at low temperatures.

A video of the instrument has been placed here: <https://www.youtube.com/watch?v=jW-xSMMXF50>

Technical Specifications

- Capable of running up to 4 different temperature-controlled head tools during the same printing run. The 4 independent Z-axes can print different material without changing cartridges.
- Ability to use a piezo-electric dispensing pipette (heatable and non-heatable) for single droplet volumes ranging from 60-500 pico-litres.

- Stroboscope for automatic functionality test of each individual dispenser. Ability to check the size/shape of the dispensing spots and then change the dispensing parameters (voltage/frequency) of the piezo tip to fit the sample consistency.
- The printing head can accommodate other liquid dispensers including solenoid valves (droplet volume 50 nano-litres) and other third party dispense valves/devices (e.g. PICOxMOD and DELO-DOT dosage heads adhesive dispensing head or similar) designed for high viscous media; would need compressed air, disposable cartridges/caps, and cleaning fluid.
- Optional heatable cartridge holders (temperatures up to 120°C) for dispensing low melting point thermoplastics (e.g. Polycaprolactone). Requires compressed air.
- Optional all-metal piston-based extrusion cartridge system for temperatures of up to 250°C.
- Optional nozzle for the dispensing of core-shell strands from two cartridges. Available with two-fold pneumatic control allowing two different pressures applied at the same time.
- Optional melt electrospinning i.e. dispensing of polymers at high voltage, producing very thin wires (10-20um diameter).
- Spring-loaded mounting (snap in fixation) of two microtiter/culture plates. Optional cooling of target holders and heating of samples in micro-well plate available.
- Option to offer external UV lamps (with different wavelengths) on the dispensing head for polymer curing.
- Optional camera system for cartridge holder (for monitoring purposes only)
- 3-Axis light barrier for automatic XYZ offset correction for each dispensing tool (provides automatic alignment).
- Automatic cleaning brush for dispense needles.
- Automated Z-height control for interchangeable build platforms with Z-level sensor.
- Printer step width/movement accuracy 2um in X/Y, 10um in Z direction.
- Working area X/Y/Z: 100 x 346 x 40mm
- Positioning speed up to 50cm/second.
- Windows 10 PC, preconfigured with software. Graphical user interface for instrument control and CAD import of STL files.
- Modular approach, all options can be upgraded post sales; the system "grows" with the applications.