

Protocol on the achievement of the Gfunk result: Functional Sample TO01000309-V14

Achieved within the TACR KAPPA /EEA project no. TO01000309 with the title:

Low-temperature 3D Printing of Bio-Functionalized Ceramic Bone Implants with Adjustable Mechanical Properties

Result name:

3D print head for low-temperature extrusion printing of pastes and hydrogels

Result Description:

The technical solution pertains to a 3D print head designed for mechanical pressure-assisted 3D printing of low-volume viscoelastic materials at ambient laboratory temperatures. This invention constitutes a print head specifically tailored for extrusion 3D printing of viscous-liquid materials (pastes, hydrogels etc.) under laboratory conditions. This print head has the capability to replace the existing print heads found in conventional desktop 3D printers.

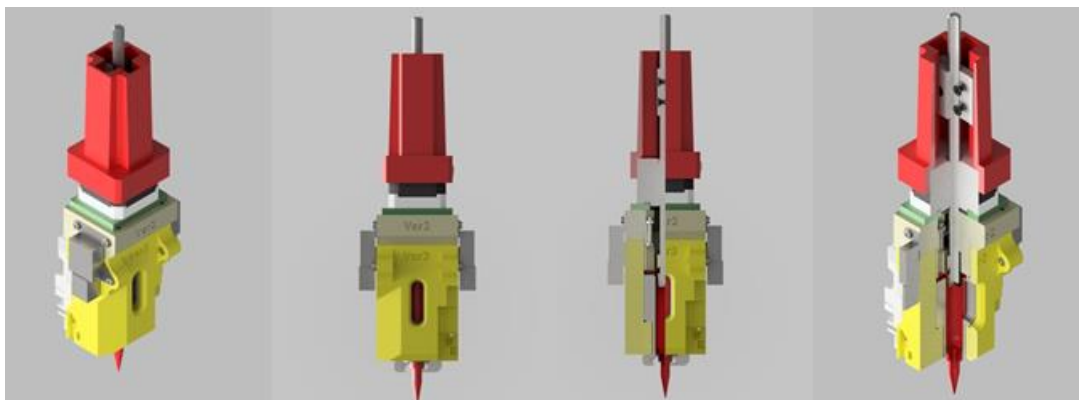


Figure 1 Schema of 3D extrusion print head for low-temperature printing of pastes and hydrogels.

Basic Parameters of Functional Sample

An overview schema of the 3D print head is shown in Figure 1, and a drawing of its assembly is shown in Figure 2. The printhead assembly is composed of several components. The unique parts are the Mechanism holder (Držák motoru), Hex reducer (Redukce Hex), Motor head insertion (Vložka hlavy motoru), Motor head (Hlava motoru), Motor spacer (Mezikus motoru), End nut (Koncová matice), Screw stabilizer (Stabilizátor šroubu) and Stabilizing hat (Stabilizační klobouk). The print head assembly is then completed with the following commercial parts: NEMA 17 NonCaptive motor, Trapezoidal screw (Trapézový šroub motoru), Optimum syringe barrel and a pair of box locks. These commercial parts are not subject to the invention.

The paste extrusion is driven by a standard NEMA17 series stepper motor with an operating voltage of 24 V and a displacement force of at least 470 N. The motor is electrically connected directly to the 3D printer's control base plate, replacing the original extruder motor. Therefore, the voltage and step count parameters of the NonCaptive motor must match those of the original motor. A non-terminated trapezoidal screw with a diameter of 6 or 8 mm and a screw length of at least 200 mm passes through the motor. The parts Mechanism holder (fixed part of the assembly) and Motor head (removable part of the assembly) are attached to each other by a pair of box locks located on the sides of the assembly.

The individual parts of the print head are designed by the FDM /Fuse Deposition Modeling 3D printing method. The print head can be made from different polymer filaments based on PLA (polylactide), PET (polyethylene terephthalate), PETG (polyethylene terephthalate + glycol), ABS (Acrylonitrile butadiene styrene), or corresponding composites.

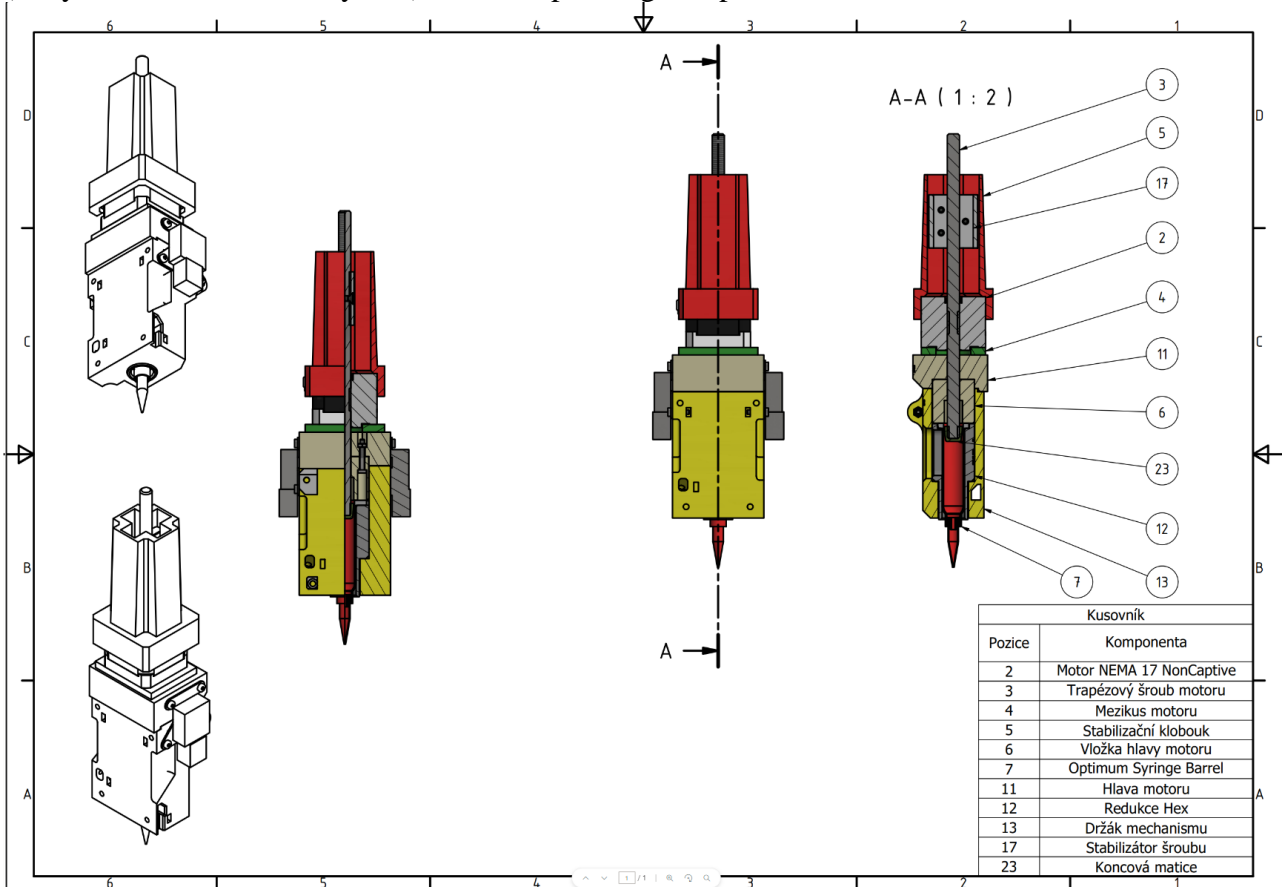


Figure 2 Schema of 3D extrusion print head assembly for low-temperature printing of pastes and hydrogels.

Examples of extrusion printing of composite ceramic paste and hydrogels:

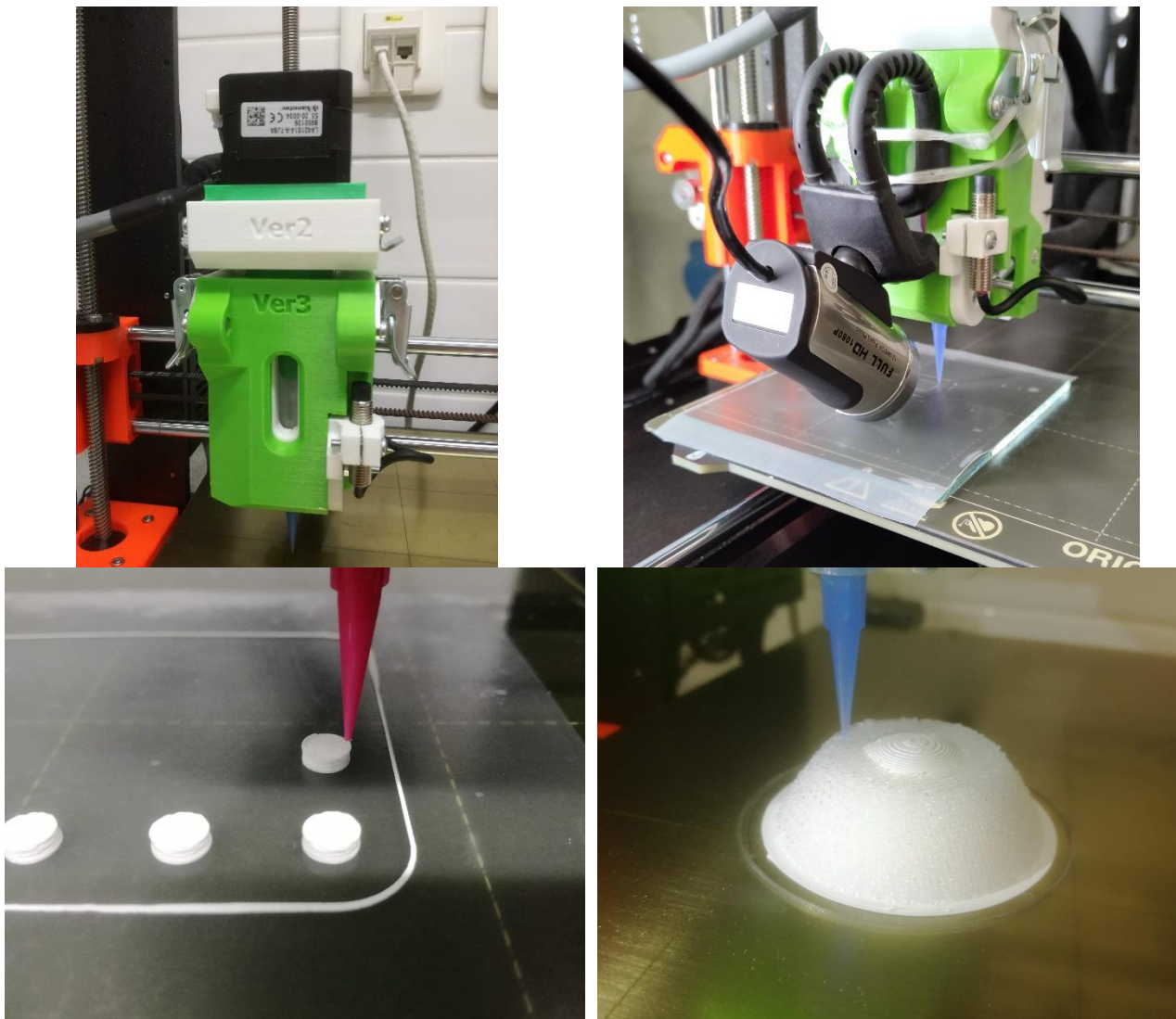


Figure 3 Schema of 3D extrusion low-temperature printing of composite ceramic paste (left) and hydrogel (right).

Result achieved: 2024-04-30

ANNEX: All results and measured parameters are described more specifically in the Final report of the TACR KAPPA /EEA project no. TO01000309 for the year 2024.

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