Implementation of entry-level bioprinters for biotechnological applications

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Advances in printing technologies and the increasing availability of printable materials render 3D printing a promising technology for biotechnological and pharmaceutical applications. By processing plastics or metals, 3D printing enables biotech laboratories to develop custom-made lab equipment or even completely new tools through rapid prototyping. However, the production and processing of biocompatible materials is required for the integrated printing of biologically active components, such as proteins and cells. The 3D printing of biological or biocompatible materials, designated as bioprinting, is nowadays almost exclusively applied for tissue engineering and regenerative medicine. One of the reasons why bioprinting apart from tissue engineering is still a neglected methodology, is certainly the tedious process of becoming a well-established and applicable technology. The commercially available bioprinters capable of printing the so called bioinks and hydrogels are expensive and strongly targeted for the printing of cells and the provision of cell-friendly printing environments. As a consequence, the access to these printers is strictly regulated and therefore impedes the application in non cell-based investigations.

Here, two entry-level bioprinters are presented, which have been developed by simple and affordable technical modifications of conventional polymer printers. These are on the one hand a low-cost Fused-Filament-Fabrication 3D printer and on the other one hand a Digital Light Processing system. The applicability of these bioprinting systems is demonstrated by case studies using poly(ethylen glycol) diacrylate as main hydrogel component and enzymes as biological active component. Protein containing hydrogel structures are handled in multiwell plates enabling the implementation of printed biomaterials in liquid handling station based high-throughput process development (HTPD). This approach permits the investigation of hydrogels and their surrounding liquid phase for biological applications. The presented entry-level concept combining bioprinting and HTPD is capable to accelerate the development of bio-synthetic hybrid materials and their processing into functional three-dimensional objects.