



3D Laser printing of nanoparticles and living cells

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Laser printing can be used for printing very small and delicate objects like nanoparticles and living cells. Nowadays, 3D printers can be bought for less than 500 Euro. They are able to print three-dimensional structures from thermoplastic and other materials. Here we report on laser printing of nanoparticles and living cells.

We demonstrate a simple printing method allowing the generation and arrangement of spherical metal and dielectric nanoparticles in a very precise manner. For example, the printed silicon nanoparticles have a predefined size and are characterized by unique optical properties. With sizes in the range of 100-200 nm in diameter they exhibit pronounced electric and magnetic dipole resonances within the visible spectral range. Fabrication, characterization, and applications of the generated nanoparticle arrays will be discussed.

In a series of publications on laser printing of living cells we proved that cells are not harmed by the printing process. The differentiation behavior and potential of laser printed stem cells are not affected. Stem cells can be printed in defined patterns and then differentiated within these patterns towards bone, cartilage or adipose tissue. With specific multi-cellular cell structures, studies of cell-cell and cell-environment interactions can be performed. Furthermore, fibroblast and keratinocyte cells have been printed layer-by-layer to form 3D skin tissue constructs. The skin tissue formation has been proven by visualizing intercellular junctions and verifying their functionality. The presented laser printing techniques are promising for a wide range of applications in nanophotonics and tissue engineering.