Influence of Material and Process Interactions in Two-Photon Polymerization: Application-Oriented Methods for Resolution Analysis

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The development of additive manufacturing devices, utilizing the principle of multi-photon-polymerization, has advanced rapidly. Such devices stand out for the ability to produce complex 3-dimensional structures with resolutions below the diffraction limits of optical systems. The polymerization process of a photo sensitive resin is induced when two photons are absorbed almost simultaneously [1]. The polymerized material in the focus point of the laser beam is elliptical shaped and called a voxel. The dimensions of the voxel depend on various variables, e.g., resin properties. The process consists of complex interactions of resin, system parameters (wavelength) and fabrication parameters (slicing/hatching). Different researcher investigated the voxel geometries of their two-photon-lithography workstations to get an insight of the resolution limits of the systems [2,3]. Since the workstation in these studies were developed in their work, a direct transfer of the generated knowledge on commercial system is not possible.

The aim of this work is to create an insight of the resolution limits of the used materials and the workstation that is transferable to other systems. Therefore, a parameter study for various resins with a commercially available two-photon-lithography workstation is performed. The first step for the investigation of the material properties is to determine the process window to induce the polymerization process. With the knowledge of the process window the interactions and influence of different laser parameter can be investigated and the resulting voxel dimensions analyzed and compared. The goal is to create a method for different resins that can be used by other research groups.

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References:

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