Direct 3D Printing of Smooth Optical Elements

Yves Garmshausen[1], Martin Herder[1]

[1]xolo GmbH, Volmerstr. 9B, 12489 Berlin, Germany

Among the various techniques in the field of additive manufacturing, the highest resolution is achieved by photopolymerization based approaches. The most used techniques are layer-by-layer based such as SLA (stereolithography) or DLP (digital light processing). The photopolymerization of one layer after the other causes interfaces between these layers due to different degrees of polymerization resulting in anisotropic objects. Furthermore, the stepwise printing process causes steps on the surface. Consequently, for 3D-printing of optical elements, another approach is required, such as volumetric printing where the polymerization is induced inside of a volume of monomer. While the well-known Two-Photon-Polymerization has low build rate and requires a pulsed laser source of high intensity, dual color volumetric printing (xolography) is presented as an alternative.

A specifically developed photoswitchable photoinitiator is pre-activated with light of a first wavelength and initiates upon subsequent absorption of light of a second wavelength. In such an approach every voxel within a monomer volume can be individually polymerized at the intersection of the light of both wavelengths. The first wavelength (UV) is provided in the form of a light sheet which is moved through a cuvette, while a movie is projected onto the light sheet. This fast and continuous printing process results in isotropic objects due to the absence of layer-layer interfaces. Moreover, smooth surfaces are directly obtained after post-curing without any further treatment such as coatings.

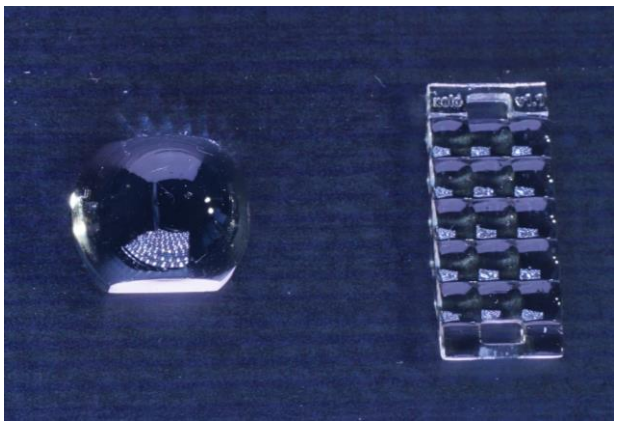

Figure 1. Optical elements printed with Xolography.

References

1. M. Regehly et al., Nature, 588, 620–624, 2020.