NIR-SENSITIZED PHOTOPOLYMERIZATION FOR LITHOGRAPHY-BASED CERAMIC MANUFACTURING

Yazgan Mete,[a] Patrick Knaack,[a] Martin Schwentenwein,[b] Bernd Strehmel[c] and Robert Liska[a]

[a]Technische Universität Wien, Institute of Applied Synthetic Chemistry, Getreidemarkt 9/163 MC, 1060 Vienna, Austria
[b]Lithoz GmbH, Mollardgasse 85a/2/64-69, 1060 Wien, Austria
[c]Niederrhein University of Applied Sciences, Department of Chemistry and Institute for Coatings and Surface Chemistry, Adlerstr. 32, D-47798 Krefeld, Germany

The importance of photopolymerization and photochemically curable materials has increased significantly in the field of 3D-printing. An advanced technique for the production of complex and precise ceramic parts is Lithography-based ceramic manufacturing (LCM), where structures are built in a layer by layer photopolymerization process [1]. Therefore the deployed mixtures do not only contain monomers and photoinitiators, but also up to 50-60 vol% ceramic powders, which considerably decrease the curing depth of the printed layers. In a layer by layer printing technique however this has a strong influence on the manufacturing time, which leads to an attempt to increase the curing depth in spite of the appearance of light scattering in filled systems [2]. In general high wavelength light sources are used to increase the penetration of materials and consequently also the depth of curing. Considering that most of the common photoinitiators only work in the UV- or lower visible light range, the absorption can be shifted to higher wavelengths by using a photosensitizer. For our investigations a cyanine dye was chosen, which exhibits excellent absorption in the NIR-area, and reactivity analysis in combination with different initiators was made. To further improve the efficiency of the selected photoinitiating system, different monomers and additives were deployed. Additionally photopolymerization of hybrid systems combining radical and cationic photopolymerization were carried out and stability tests of the dye/initiator system were performed. Also the maximum curing depth with the introduced initiating system was investigated in unfilled as well as in filled systems.

[1] Homa, J.; Schwentenwein, M., A Novel Additive Manufacturing Technology for High-Performance Ceramics. In Advanced Processing and Manufacturing Technologies for Nanostructured and Multifunctional Materials, John Wiley & Sons, Inc.: 2014; pp 33-40.

[2] Griffith, M. L.; Halloran, J. W. Journal of Applied Physics 1997, 81, (6), 2538-2546.