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Kinetics of nanostructural and interfacial evolution induced by photopolymerization for submicrometer additive manufacturing

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Photopolymerization offers excellent spatial resolution, low energy consumption and high curing speeds, making it a widely used industrial technology with great potential in additive manufacturing application. The kinetics of spatial and temporal nanostructural evolution and the interfacial formation in resin multilayers are the key to achieve controllable and high-precision manufacturing. In detail, the photopolymerization-induced transformation of resins from as-deposited to solid and cross-linked state needs to be correlated to the physical transformations. Here, we use spin-coated UV-curable multilayer films as research model. We investigate the kinetics of the nanostructure and interfacial evolution by modulating precursor resin components (solvents, active diluents, and glass temperature conditioning agents). Combining atomic force microscopy (AFM), scanning electron microscopy (SEM), and grazing incidence small angle X-ray scattering (GISAXS), the UV-curing induced nanoscale morphology as well as the buried interlayer interface of the multilayer films are probed. We reveal the kinetics of solvent- and reactive diluent-induced interface evolution in photocurable multilayer film fabrication. This paves the way for sub-micrometer additive manufacturing with high precision and controlled nanomorphology.

Primary author: CHEN, Shouzheng (Physik-Department, Lehrstuhl für Funktionelle Materielien, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany)

Co-authors: ZHAI, Yufeng (Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany); ZHOU, Jungui (Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany); ZHANG, Jinsheng (Physik-Department, Lehrstuhl für Funktionelle Materielien, Technische Universität München, James-Franck--Strasse 1, 85748 Garching, Germany); PAN, Guangjiu (Physik-Department, Lehrstuhl für Funktionelle Materielien, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany); EVERETT, Christopher (Physik-Department, Lehrstuhl für Funktionelle Materielien, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany); GUO, Yingjian (Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany); A.T.M. VAN BENTHEM, Rolf (Eindhoven University of Technology, Laboratory of Physical Chemistry (SPC), Groene Loper 5, 5600, MB, Eindhoven, the Netherlands); F.G.A. JANSSEN, Johan (DSM Material Science Center, Urmonderbaan 22, 6167, RD, Geleen, the Netherlands); K. G. JOHANSSON, Mats (KTH Royal Institute of Technology, Fiber and Polymer Technology, Teknikringen 56, 10044, Stockholm, Sweden); MÜLLER-BUSCHBAUM, Peter (Physik-Department, Lehrstuhl für Funktionelle Materielien, Technische Universität München, James-Franck--Strasse 1, 85748 Garching, Germany); V. ROTH, Stephan (Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany)

Presenter: CHEN, Shouzheng (Physik-Department, Lehrstuhl für Funktionelle Materielien, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany)

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