TRACKING PHYSICAL TRANSFORMATIONS DURING PHOTO-INDUCED NETWORK FORMATION BY REAL TIME X-RAY SCATTERING

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Photo-induced polymerization is a key enabling technology offering spatial and temporal control to allow for future functional materials. Though numerous approaches both experimentally as well as theoretically have been conducted, many open questions on the evolution of the network morphology on the nanoscale during photo-induced conversion leading to the macroscopically observable characteristics remain. Here, we employ a novel approach to correlate chemical transformations during photo-polymerization of acrylate-based resins with their morphological evolution at the nanoscale [1]: We use a combination of traditional techniques (FTIR, AFM) and advanced real-time synchrotron-based scattering methods. We are able to visualize how local physical arresting in the liquid, associated with both cross-linking and vitrification, determine the length scale of the local heterogeneities forming upon curing, found to be in the 10–200 nm range. This approach furthermore yields simultaneous access to surfaces (roughness) and volume morphology (inhomogeneities, correlation lengths) during the conversion / network formation. The results obtained here provide a deeper insight into the photo-induced formation of structural polymer networks, thereby allowing the tailored engineering of high-performance materials in fields as diverse as advanced electronics and 3D printing [2].

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[1] Brett, C. J., et al., Commun. Chem. 2020, 3 (1), 88. https://doi.org/10.1038/s42004-020-0335-9

[2] Glier, T. E.; et al., Sci. Rep. 2019, 9 (1), 6465. https://doi.org/10.1038/s41598-019-42841-3