HIGH PERFORMANCE INTERPENETRATING POLYMER NETWORKS FOR HOT LITHOGRAPHY

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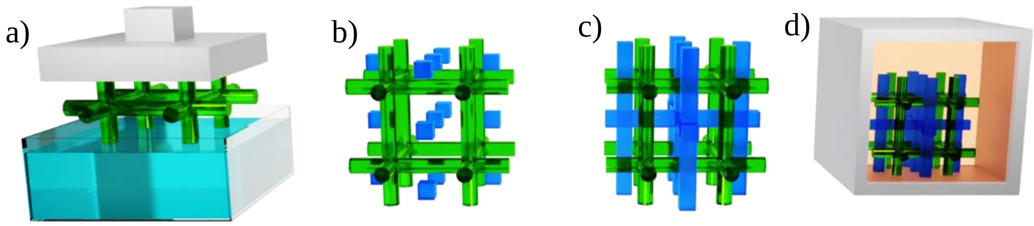
The versatility of lithography-based 3D-printing technologies led to its establishment in today's industry. Complex and highly individualized products are possible, though they also hold some disadvantages. The yielded polymers lack toughness and suffer from overall bad mechanical performance.

We decided to tackle this problem by utilizing an epoxide-alcohol system within a methacrylate matrix. The epoxide-alcohol system provides good mechanical performance, while the methacrylate acts as a scaffold for the 3D-printing process. Combined an IPN is yielded with good printability as well as good mechanical properties like high toughness.
Each network is optimized separately. For the epoxy-alcohol system, the twist is that we have a polyaddition reaction, with low reaction speed but good mechanical properties. These properties are achieved by the high network homogeneity. The low curing speed of the epoxide alcohol system is circumvented by introducing a radical system that acts as a scaffold and enables printing.



a) printing of the soft network b) soft network soaked with uncured hard network c) cured IPN d) post-curing of the IPN to ensure full conversion

The networks were tested with respect to their (thermo)mechanic behaviour. For this purpose, tensile tests as well as DMTA measurements were performed. The polymers that seemed most promising were combined into one IPN and again tested on these properties to yield the best-performing IPN.

For additive manufacturing as a possible application, a dual cure approach was chosen wherein sequential, semi-orthogonal light-curing was applied. This way fast printing can be combined with the slowly curing alcohol epoxide system and its benefits for the mechanical properties.