

The Art of Network Design

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We discuss several methods of designing polymer networks and gels and different ways of making these networks tougher, including using stored length and sacrificial bonds, slide rings, entanglements, and microphase separation.

It turns out that whether weaker or stronger crosslinks lead to tougher networks depends on the placement of these crosslinks – either as parts of network strands or as connections between primary chains.

The optimal strength of the sacrificial crosslinks and their concentration depends on the strength of the primary chain bonds.

An interplay between main chain pull-out and bond cleavage depends on the deformation rate.

A combination of these approaches in double networks utilizes double microphase separation on two different scales.

All these methods lead to the narrowing of the tension distribution in network strands and, most importantly, the reduction of tension in the overstretched strands.