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Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

Novel silicone compatible cross-linkers for controlled and well distributed functionalization of PDMS networks

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Dielectric electro active polymers (DEAPs) are polymeric network systems that can be used to convert an electrical input to mechanical deformation of a polymer. DEAPs can be applied as actuators, sensors and generators due to their ability to exhibit a change in size and shape when an external voltage is applied as well as generate electrical energy when a mechanical deformation is induced. DEAPs are normally constructed from thin filled elastomer films sandwiched between two compliant electrodes.[1]

Polydimethylsiloxane (PDMS) is one of the most used materials for DEAP applications due to its good thermal stability, high efficiency and fast response.[2] To obtain high actuation strain of DEAPs, the activation voltage is in general too high for many practical applications. One method to lower the activation voltage is to increase the dielectric permittivity of the elastomer film. The aim of this work is to increase the dielectric permittivity by creating new functional PDMS networks. This is done by the design of a novel silicone compatible cross-linker that allows for orthogonal chemistry and contains both vinyl groups for cross-linking reactions with hydride-terminated PDMS and an azide functionality that opens up for click reactions. In this case, the copper-catalyzed cycloaddition of an azide group and an alkyne (CuAAC) forming a 1,4-disubstituted-1,2,3-triazole.[3,4] In this way, functionality such as dipole molecules can be incorporated into the PDMS network at the cross-linking point in a controlled and well distributed way (Figure 1). Even very small loadings (<1 wt %) of incorporated dipoles have led to a large increase in the dielectric permittivity.

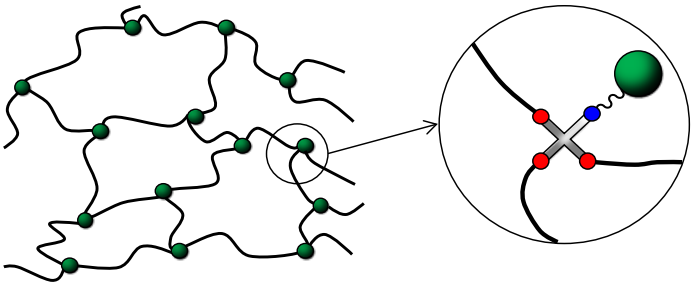

Figure 1: PDMS network with incorporated functionality at the cross-linking point.

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