DTU Library

Unimodal and bimodal networks performance as dielectric electroactive polymers (DEAPs)

Bejenariu, Anca Gabriela; Daugaard, Anders Egede; Skov, Anne Ladegaard

Publication date:
2012

Citation (APA):
Bejenariu, A. G., Daugaard, A. E., & Skov, A. L. (2012). *Unimodal and bimodal networks performance as dielectric electroactive polymers (DEAPs)*. Abstract from 49th Nordic Polymer Days 2012, Copenhagen, Denmark.

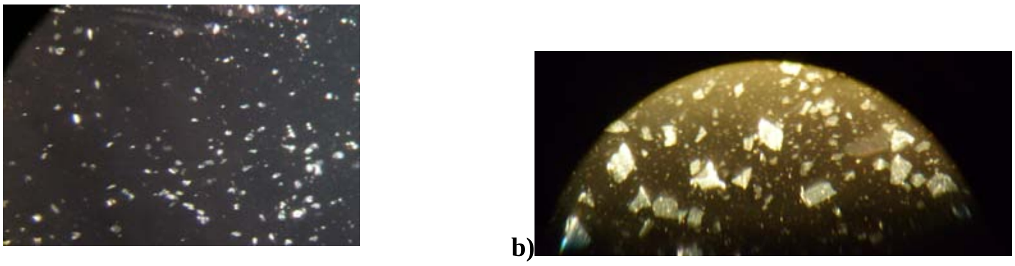
Unimodal and bimodal networks performance as dielectric electroactive polymers (DEAPs)

Anca Gabriela Bejenariu[a], Anders Egede Daugaard[a], Anne Ladegaard Skov[a]

[a]DTU, Department of Chemical and Biochemical Engineering, Kgs. Lyngby

A polymer network is a three-dimensional entity formed by the interconnection of polymer chains and is sometimes referred to as an elastomer in the case of highly elastic material. Most model elastomers are prepared by an end-linking process using a crosslinker with a certain functionality *f* and a linear polymer with functional groups in both ends, and the resulting networks are so-called unimodal networks where unimodal refers to that there is one polymer only in the system. As an alternative to unimodal networks there are the bimodal networks where two polymers with significantly different molecular weights are mixed with one crosslinker[1].

Lately, dielectric electroactive polymers (DEAPs) which consist of an elastomer sandwiched between electrodes on both sides, have gained interest as materials for actuators, generators, and sensors. When a voltage is applied between the two electrodes an electrostatic field is created and the charges from the electrodes will attract each other, determining a decrease in the thickness of the film and an expansion in the area. Most of the actuators rely on commercial available silicone and acrylic soft elastomers which initially were not developed for DEAPs applications. Hence, optimization of the elastomeric material improvement should be possible to meet the requirements of DEAPs. The electro-mechanical properties of silicone networks can be improved by addition of fillers. In the present study the optimization of electromechanical properties of both unimodal and bimodal silicone based networks is achieved by addition of different types and loadings of fillers. Optical microscopy pictures of microfillers and nanoclays in silicone networks are presented in Figure 1.



a) b)

Figure 1. Optical microscopy pictures with a magnification of 400 are taken for a) ElastosilRT 625 networks loaded with microparticles of 6μm and b) silicone networks loaded with nanoclays (300x300x1 nm).

Using a hydrosilylation addition reaction at room temperature between vinyl-terminated polydimethyl siloxanes (PDMS) and a 4-functional crosslinker in presence of platinum catalyst, silicone networks are synthesized. Different molecular weights of PDMS, different mixing procedures and various numbers of reaction steps are used. Several types of fillers (nano- and microparticles, nanoclays) and varied loadings are used to improve the electromechanical properties of both unimodal and bimodal soft networks. Emphasis is made on the combination of the fillers to increase the dielectric strength and to maintain the high flexibility of the network. As industrial reference for the electromechanical properties, ElastosilRT 625 networks (Wacker Chemie) are used. Rheological and dielectric measurements are recorded and compared with the DEAPs requirements for actuators application. The microfillers will increase the Young's modulus, while the nanoclays seem to be good candidates for enhancement of the dielectric permittivity of the networks. Finally, networks loaded with fillers with good electromechanical properties are synthesized and proposed for DEAPs applications.

1. Bejenariu, A. G.; Yu, L.; Skov, A. L., Low moduli elastomers with low viscous dissipation. *Soft Matter* **2012,** D*OI=10.1039/b803770c*.