Super soft silicone elastomers with high dielectric permittivity (EAPAD 2015)

Dielectric elastomers (DEs) have many favourable properties. The obstacle of high driving voltages, however, limits the commercial viability of the technology at present. Driving voltage can be lowered by decreasing the Young’s modulus and increasing the dielectric permittivity of silicone elastomers. A decrease in Young’s modulus, however, is often accompanied by the loss of mechanical stability and thereby the lifetime of the DE. New soft elastomer matrices with high dielectric permittivity and low Young’s modulus, with no loss of mechanical stability, were prepared by two different approaches using chloropropyl-functional silicone polymers. The first approach was based on synthesised chloropropyl-functional copolymers that were cross-linkable and thereby formed the basis of new silicone networks with high dielectric permittivity (e.g. a 43% increase). These networks were soft without compromising other important properties of DEs such as viscous and dielectric losses as well as electrical breakdown strength. The second approach was based on the addition of commercially available chloropropyl-functional silicone oil to commercial LSR silicone elastomer. Two-fold increase in permittivity was obtained by this method and the silicone oil decreased the Young’s modulus significantly. The viscous losses, however, also increased with increasing content of silicone oil. Cross-linkable chloropropyl-functional copolymers offer a new silicone elastomer matrix that could form the basis of dielectric elastomers of the future, whereas the chloropropyl silicone oil approach is an easy tool for improvement of the properties of existing commercial silicone elastomers.

General information
State: Published
Organisations: Department of Chemical and Biochemical Engineering, The Danish Polymer Centre
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Number of pages: 14
Publication date: 2015

Host publication information
Title of host publication: Proceedings of SPIE: Electroactive Polymer Actuators and Devices (EAPAD) 2015
Volume: 9430
Publisher: SPIE - International Society for Optical Engineering
Editor: Yoseph, B.
Article number: 94301D
Keywords: Elastomer, Silicone, Dielectric permittivity, Low dielectric loss, Low mechanical loss, Breakdown
Electronic versions:
94301D.pdf
DOIs:
10.1117/12.2082929

Bibliographical note
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Research output: Research - peer-review › Article in proceedings – Annual report year: 2015