Functional silicone copolymers and elastomers with high dielectric permittivity - DTU Orbit (09/11/2017)

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Dielectric elastomers (DEs) are a new and promising transducer technology and are often referred to as 'artificial muscles', due to their ability to undergo large deformations when stimulated by electric fields. DEs consist of a soft and thin elastomeric film sandwiched between compliant electrodes, thereby forming a capacitor [1]. Silicone elastomers are one of the most used materials for DEs due to their high efficiency, fast response times and low viscous losses. The major disadvantage of silicone elastomers is that they possess relatively low dielectric permittivity, which means that a high electrical field is necessary to operate the DE. The necessary electrical field can be lowered by creating silicone elastomers with higher dielectric permittivity, i.e. with a higher energy density.The aim of this work is to create new and improved silicone elastomers with high dielectric permittivity. This was done trough the synthesis of new functionalizable siloxane copolymers [2] that allow for the attachment of high dielectric permittivity molecules through copper-catalyzed azide-alkyne 1,3-dipolar cycloaddition (CuAAC) reactions. The synthesised siloxane copolymers were prepared via the tris(pentafluorophenyl)borane catalysed Piers-Rubinsztajn reaction [3] and have a high degree of chemical freedom, as several parameters can be varied during the preparation phase. Thus, the space between the functional groups can be varied, by using different dimethylsiloxane spacer units between the high dielectric permittivity molecules. Furthermore, the degree of functionalization of the copolymers can be varied accurately by changing the feed of the high dielectric permittivity molecules. As a result, a completely tuneable elastomer system, with respect to functionalization, is achieved.

General information

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