Technical University of Denmark

Improving dielectric permittivity by incorporating PDMS-PEG block copolymer into PDMS network

A Razak, Aliff Hisyam; Szabo, Peter; Skov, Anne Ladegaard

Publication date:
2015

Document Version
Peer reviewed version

Improving dielectric permittivity by incorporating PDMS-PEG block copolymer into PDMS network

Aliff H. A Razak (ahis@kt.dtu.dk), Peter Szabo and Anne Ladegaard Skov

Danish Polymer Center, Department of Chemical and Biochemical Engineering, Technical University of Denmark, Building 227, 2800 Kgs. Lyngby Denmark

Polydimethylsiloxane (PDMS) based elastomers are well-known to actuate with large strain mainly due to their low modulus and their non-conducting nature. On the other hand, polyethyleneglycols (PEG) are not stretchable but they have high permittivity and are conductive. Combination of the two polymers as a block copolymer depicts a possibility for substantial improvement of properties such as high permittivity and non-conductivity – if carefully designed. The objective is to synthesize PDMS-PEG multiblock copolymer assembling into different morphologies[1] such as lamellar, cylinder, gyroid and spheres based on variation of volume fractions of PDMS and PEG. The synthesis is amended from Klasner et al.[2] and Jukarainen et al.[3] Variation in the ratio between the two constituents introduces distinctive properties in terms of dielectric permittivity and rheological behaviour. PDMS-PEG multiblock copolymer-based elastomers of different volume fractions exhibit high storage permittivity but they are conductive. By incorporating conductive PDMS7-PEG multiblock copolymers into a commercial non-conductive PDMS elastomer (MJK) creates a promising morphology which enhances storage permittivity (ε') by 60% with 5wt% of PDMS7-PEG block copolymer incorporated in the PDMS network.

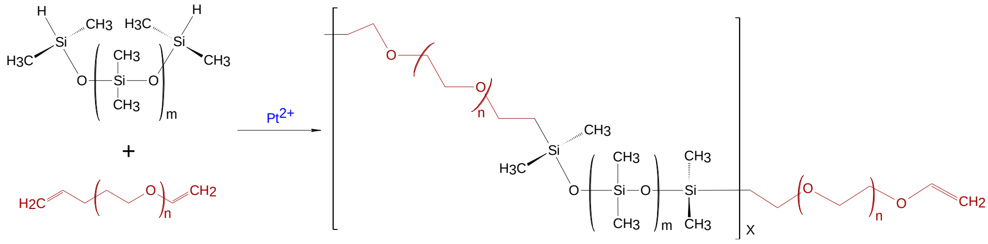

Fig. 1: Hydrosilylation reaction of PDMS-PEG multiblock copolymer with presence of platinum catalyst

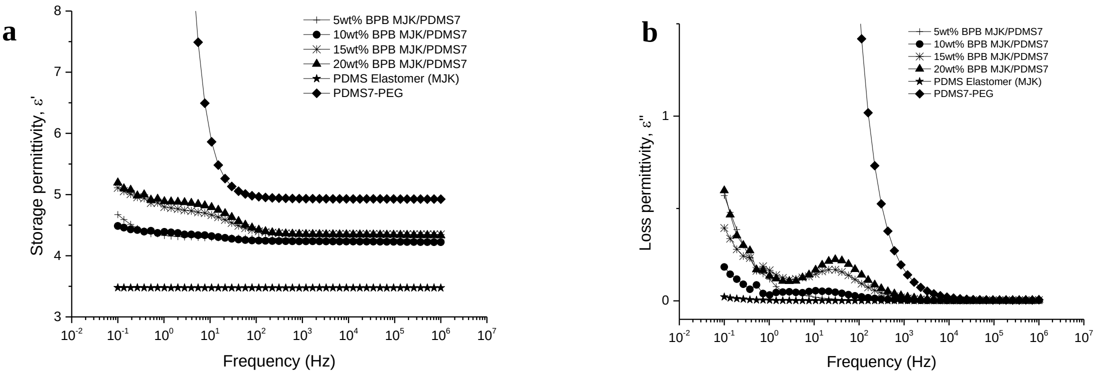

Fig. 2: Dielectric properties of samples a) Storage permittivity and b) Loss permittivity at 23 °C.

References

1 Bates FS, Fredrickson GH (1999) "Block copolymers—Designer soft materials". *Phys Today* 52:32

2 Klasner SA, Metto EC, Roman GT, Culbertson CT (2009) "Synthesis and characterization of a poly(dimethylsiloxane)-poly(ethylene oxide) block copolymer for fabrication of amphiphilic surfaces on microfluidic devices". *Langmuir* 25:10390–6

3. Jukarainen H, Clarson S, Seppala J, Oy L (2000) "Surface and phase studies of multi block PDMS.B-PEO copolymers". *Am Chem Soc* 729:353–357