Soft-Hard Hybrid Filler for Silicone Based Dielectric Elastomer: Glycerol and Titanium Dioxide

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Abstract. Polydimethylsiloxane (PDMS) film can be operated at broader temperature range and has mechanical properties such as low viscous loss and high tear strength. Due to its outstanding thermal and mechanical performances, it has been used as silicone based dielectric elastomer (DE). For DE, the material that need less applied voltage but has high actuation strain is more favorable as it offers fewer risks of electrical failure and energy consumption. However, PDMS film typically has low relative permittivity (2.5-3.0) that requires high applied voltage in order to obtained high actuation strain. Therefore, several strategies have been introduced to increase relative permittivity of PDMS films such as compositing. The incorporation of high permittivity fillers into PDMS film has been reported can increase the relative permittivity to some extent; however, it also comes with negative effect to other important DE's parameters such as high Young's modulus and low breakdown strength. Therefore, the purpose of this study is to increase relative permittivity of PDMS film through addition of high permittivity fillers without sacrifice the other important DE's parameters through filler hybridization and at the same time to investigate the synergetic effect of filler hybridization (soft-hard filler) on the mechanical and electrical performances of DEs. The results show that incorporated TiO2/Glycerol oil at ratio 1:1 into PDMS films demonstrates the most significant increases of relative permittivity to three-fold higher than pure PDMS. Interestingly, at the same time, this soft-hard hybrid filler technique upholds the mechanical and electrical integrity of PDMS films.