Development of a Silicone Dielectric Polymer for Actuators

D.M.N.T. Dissanayake[1], A.U. Asela[1*], A.K.C.P. Premarathna[1], G.A.A.I. Tennakoon[2] and R.L. Samaraweera[1]

[1]Department of Science and Technology, Uva Wellassa University, Sri Lanka
[2]Department of Engineering Technology, Uva Wellassa University, Sri Lanka
**Corresponding Author E-mail: ushan@uwu.ac.lk, TP: +94710811145*

Virtual 3D environments (Virtual Reality) are created inside computers to deliver thermal, vibrational, and force feelings. Haptics technology brings this virtual world to end-users by haptics goggles and gloves. Tactile displays have been developed to deliver sensations in haptics gloves. In this regard, actuators act as movers in tactile displays stimulating sensations to skin receptors inside the fingertips. Dielectric polymer-based actuators are prominent in the world due to lightness, lower energy loss, and simplicity leading to wearable haptics gloves. Acrylic and silicone are the major types of dielectric polymers used for actuators. Silicone dielectric polymers have excellent properties such as faster response (3 s), efficiency, lower mechanical loss, and thermal stability comparing to acrylic. But silicones unable to achieve greater electro-strains (>10%) as it's in acrylic-based actuators. This research work focused on enhancing the electro-strain property of silicone dielectric polymer by blending polyaniline particles. The electro-strain property of dielectric polymers depends on both dielectric constant and elastic modulus. Increased dielectric constant and decreased elastic modulus improve the electro-strain of actuators. Polyaniline has positive and negative charges itself which can be utilized to improve the dielectric constant of silicone polymer. Also, dispersed particles can change the elastic modulus of the matrix material. In the procedure, polyaniline and Dow corning silicone (DC 3481) were mixed in 0.0wt%, 0.5wt%, 1.0wt%, 1.5wt%, and 2wt% compositions and stirred for six hours. Next, thin films (thickness-125 μm) were prepared using the Doctor blade technique on PVC (Polyvinylchloride) sheets. Crosslinking process was carried out for 24 hours. In characterization, 2wt% Dow corning silicone (DC 3481) and polyaniline polymer blend showed the 41.76% increment in dielectric constant, and elastic modulus was decreased by 68.71% compared to pure Dow corning silicone (DC 3481). This composition achieved the best matching electromechanical properties in dielectric constant and elastic modulus to apply in actuators. The developed polymer is recommended for haptics gloves to deliver enhanced force and vibration. Moreover, the Doctor blade technique can be introduced to fabricate thin films in actuators which is simple and cost-effective.

***Keywords*:** Virtual reality (VR); Actuators; Dielectric constant; Elastic modulus