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Abstract

The DEAP (dielectric-electro active polymer) material is used in the making of actuators, sensors and generators. PDMS (polydimethyl siloxane) is a commonly used DEAP. The working principle of a DEAP actuator is similar to that of a capacitor. A thin elastomer film is sandwiched between two compliant electrodes, and a high DC voltage (kV) is applied and the arising electrostatic pressure causes expansion of the elastomer film in planar directions. The geometry of the elastomer film plays a vital role in the performance of the actuator. To enhance its performance as an actuator, the surface of the film is given micro scale corrugation lines. In the current large-scale manufacturing process by Danfoss Polypower[1], a carrier web with corrugations is used to impart these corrugations to the DEAP films.

The release and take-up of the elastomer film from the carrier web induces considerable pre-strain in the film which affects the performance of the films as actuators or generators. Presently, PETE (polyethylene teraphthalate) embossed with methyl acrylate is used as the carrier web (in Danfoss) and its compatibility with PDMS films is being examined in our labs. There is some bonding (chemical and physical) between the films and web. Replacing the carrier web is not a viable option right now as it is difficult to employ a substrate with corrugations that supports the film through the curing process and also favors easy release. An IR spectroscopy and contact angle tests on the webs revealed that the used carrier webs retained some amount of silicone (PDMS) on them which favored the release of the films.

To make the release easier, the PDMS films should have low release force or poor adhesion force with the carrier web. A polymeric additive of lower surface energy than its host matrix is known to adsorb preferentially at the free surface and consequently decreases the adhesion of that surface towards a particular substrate [2]. Thanawala et al [3] added Perfluoroether allylamide (PFE) to PDMS (0.3-1.5 weight %) and lowered its surface energy from 19 to 8 mJ/m^2. Based on this idea PDMS films were doped with trace amounts of PFE (1%) and the PDMS films had a lowered release force. The effects of PFE on the surface, mechanical and electrical properties of the film are investigated.

Key words: Carrier web, release properties, PDMS, surface properties & PFE

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