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● Surface characterization of an elastomeric composite of cornstarch and PDMS

T. Bhowmick, A. Ghatak
Indian Institute of Technology - Kanpur (IN)

Abstract content

Starch is a widely occurring natural material, which can be added as filler in various synthetic polymeric materials, e.g. poly(dimethylsiloxane) (PDMS) to yield properties like biodegradability, tunable modulus, reduced friction coefficient and high energy dissipation rate. Because of these characteristics, starch based materials can be useful for variety of applications: environment friendly packaging materials, energy dampeners, shock absorbers in machinery and most importantly a green substitute for petroleum based synthetic materials. However, how exactly a biopolymer like starch would affect the surface characteristics of the organic-inorganic hybrid material, has not yet been systematically studied. For example, it is not known how the surface topography of a composite film would get altered when crosslinked against solid substrates having different surface energy, deformability and topography. It is not known also if the crystalline or the gelatinized phase of the starch would affect differently the surface characteristics. To address these questions, we have prepared starch-PDMS composite material with varying quantity (9%, 16.7% and 29% w/w) of starch granules dispersed in the continuous matrix of the silicone. The starch granules were suspended in a solvent like tert-butyl alcohol to disperse it uniformly in PDMS, (i.e. sylgard 184 elastomer mixed with the crosslinking agent in 10:1 w/w) which is viscous. Thin layers of the dispersion were then crosslinked against surfaces of different kind: hydrophilic, hydrophobic and oleophobic, e.g. polystyrene petridish, gelatinized starch, PDMS, fluorocarbon (FC) functionalized PDMS, hydrophilic glass, FC functionalized glass and poly (2-hydroxyethyl methacrylate) (pHEMA) gel. Following curing of the liquid, we have examined the solid surface by measuring water contact angle and by scanning under optical profilometer and Field Emission Scanning Electron Microscope (FESEM). These experiments show that while the surface of the composite polymer essentially consists of the crosslinked PDMS, it turns topographically rough unlike PDMS devoid of the starch. The roughening of the surface happens even when the liquid is cured against a flat and optically smooth surface. These results indicate that while the starch remains embedded inside the polymer layer, it does affect the physical characteristics of the composite's surface.

Keywords: starch, polydimethylsiloxane, elastomer, surface topography.