SF-P017

Tribological Behaviors on nano-structured surface of the diamond-like carbon (DLC) coated soft polymer

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Tribological behaviors of the hard film on soft substrate system were explored using the hard thin film of diamond-like carbon (DLC) coated the soft polymer of polydimethysiloxane (PDMS). A DLC film with the Young's modulus of 100 GPa was coated on PDMS substrate with Young's modulus of 10 MPa using plasma enhanced chemical vapor deposition (PECVD) technique. The deposition time was varied from 10 sec to 10 min, resulting in nanoscale roughness of wrinkle patterns with the thickness of 20 nm to 510 nm, respectively, at a bias voltage of 400 V_b, working pressure 10 mTorr. Nanoscale wrinkle patterns with 20-100 nm in width and 10-30 nm height were formed on DLC coating due to the residual stress in compression and difference in Young's modulus.

Nanoscale roughness effect on tribological behaviors was observed by performing a tribo-experiment using the ball-on-disk type tribometer with a steel ball of 6 mm in diameter at the sliding speed of 220 rpm, normal load of 1N and 25% humidity at ambient temperature of 25℃. Friction force were measured with respect to thickness change of coated DLC thin film on PDMS. It was found that with increases the thickness of DLC coating on PDMS, the coefficient of friction decreased by comparison to that of the uncoated PDMS. The wear tracks before and after tribo-test were analyzed using SEM and AFM.