Heterogeneityof hard skin layer in wrinkled PDMS surface fabricated by Ar ion beamirradiation

Seunghun Lee [1], Eunyeon Byeon [1], Sunghoon Jeong [1], and Do-Geun Kim [1]

[1]*Korea Institute of Materials Science, Korea, Republic of*

A spatial distribution of binding state in depth direction is investigated in a hard skin layer on soft polydimethylsiloxane (PDMS) fabricated by Ar ion beam irradiations. The hard skin layer known as a silica-like homogenous layer was composed of two layers. Impinging Ar ions transfer energy to PDMS as a function of collisional energy transfer rate, which is the maximum at surface and decreases gradually as an ion penetrates. This formed the heterogeneous hard skin layer that consists of a top-most layer and an intermediate layer. XPS depth profiling showed the existence of the top-most layer and intermediate layer. In the top-most layer, scission and cross-linking were occurred simultaneously and Si-O bond showed dissociated status, SiO_x (x =1.25 - 1.5). Under the top-most layer, there was the intermediate layer in which cross-linking is mainly occurred and Si-O bond showed silica-like binding status, SiO_x (x = 1.75 - 2). And theoretical analysis which calculates the collisional energy transfer and a displacement per atom explained the thickness variation of top-most layer according to Ar ion energy from 360 eV to 840 eV. The comparison between the displacement per atom and XPS depth profiling showed consistency in the spatial distribution in the depth direction of both Si- and C-related bonds. The displacement per atom could be a good physical parameter to explain scission and cross-linking phenomena initiating self organized nano structures on polymer surface after ion-beam irradiations.

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