

Elucidation of Mechanisms for Bent Janus Nanopillars

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Asymmetric features have received much attention for applications such as gecko-like dry adhesives, micro fluidic systems and so forth. We have fabricated polymer-based Janus structures by nano- and micro-moldings of a photo-curable polymer combined with oblique metal deposition on the polymeric structures. With the Janus nanopillars, we were able to realize adhesion hysteresis, as can be seen from gecko feet. It shows the strong shear attachment when pulling from the direction of polymer contacts and relatively weak attachment in the opposite direction even with straight-up nanopillars. Since bent nanopillars have shown the excellent adhesion hysteresis, we bent the Janus nanopillars by different mechanisms. We obtained the bent nanopillars by taking advantage of the difference in thermal expansion coefficients between polymer pillars and metal films, as well as the residual stress during the metal deposition. In addition, by changing parameters such as oblique angle, curing time and metal thickness, we were able to control the bending angle of the nanopillars.