Supporting Information for: Enhancing the scratch-resistance by introducing chemical bonding in highly stretchable and transparent electrodes

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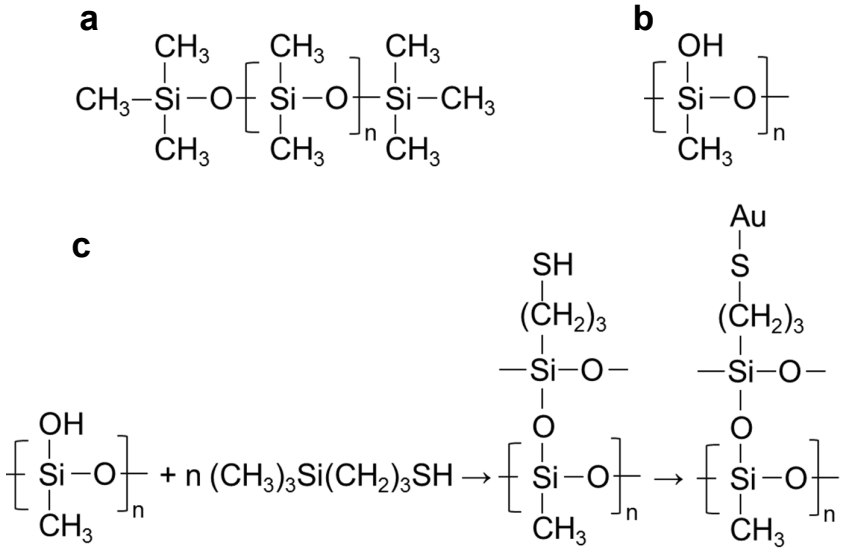


Figure S1. (a) The chemical formula of PDMS. (b) The repeated units of hydroxylated surface of PDMS. Part of the methyl units is oxidized in a mixed solution of HNO_3, H_2O_2 and water (1:1:2). (c) Ideal reactions for the deposition of the MPTMS SAM and the formation of Au-S bonds.

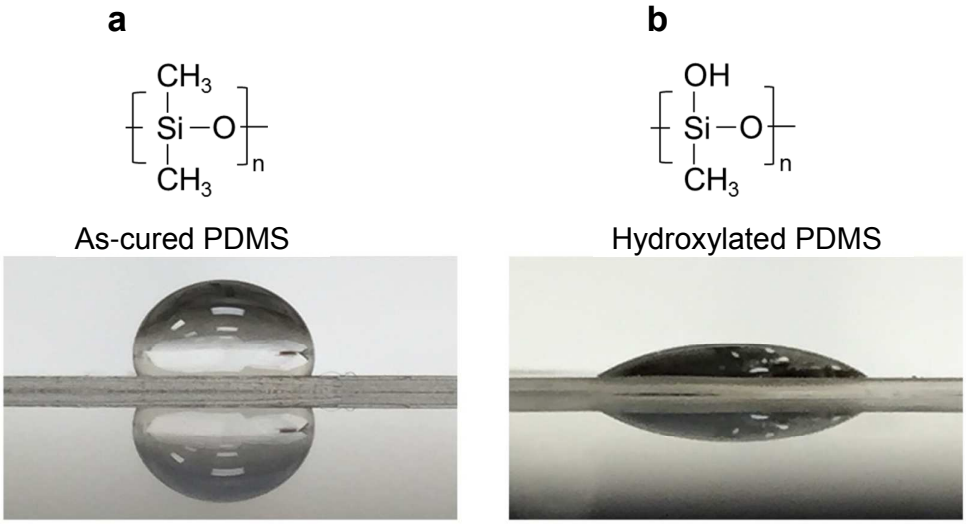


Figure S2. As-cured PDMS has methyl groups and thus it is often hydrophobic. PDMS changes from (a) hydrophobic to (b) hydrophilic after being immersed in blended solution of HNO_3, H_2O_2 and water (1:1:2 in volumetric ratio) for half an hour. The change in wettability verifies the oxidation and hydroxylation of the PDMS surface.

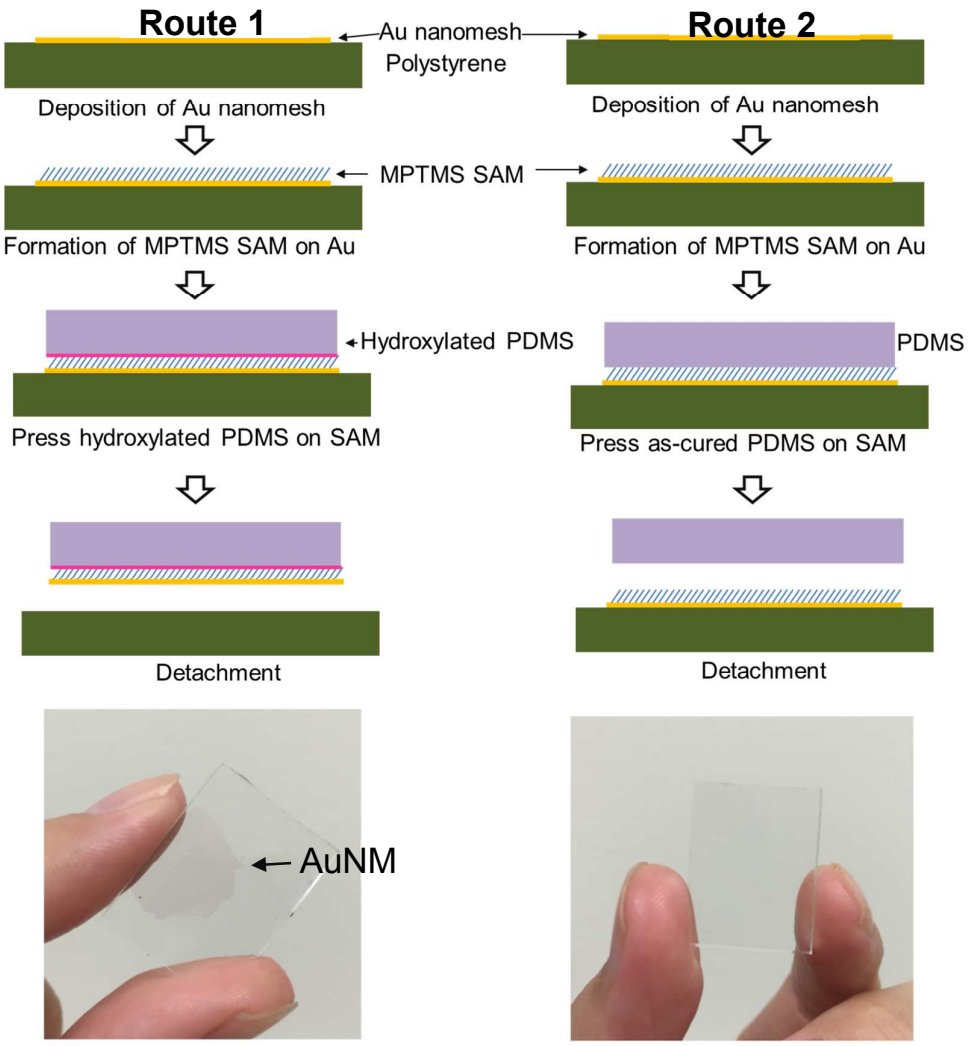
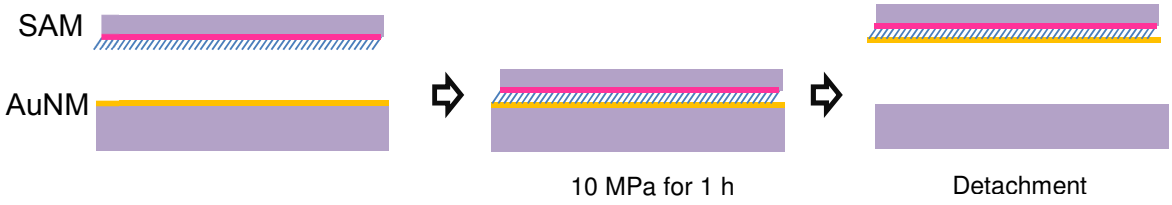


Figure S3. The silicon hydroxyls on PDMS are crucial for formation of chemical bonds. In Route 1, a AuNM assembled with a MPTMS monolayer can be detached with a hydoxylated PDMS after applying a pressure of ~10 MPa for 20 min. By contrast, as-cured PDMS cannot form a chemical bond with the MPTMS SAM, and thus it does not lift the AuNM from a polystyrene substrate.



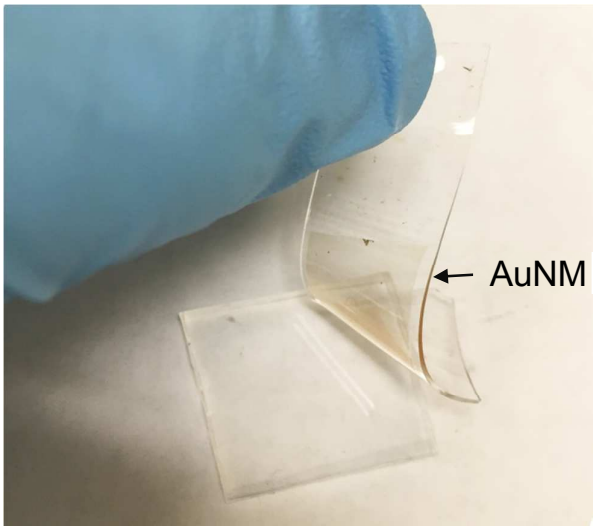


Figure S4. A PDMS substrate with a MPTMS SAM can adhere a AuNM from as-cured PDMS.

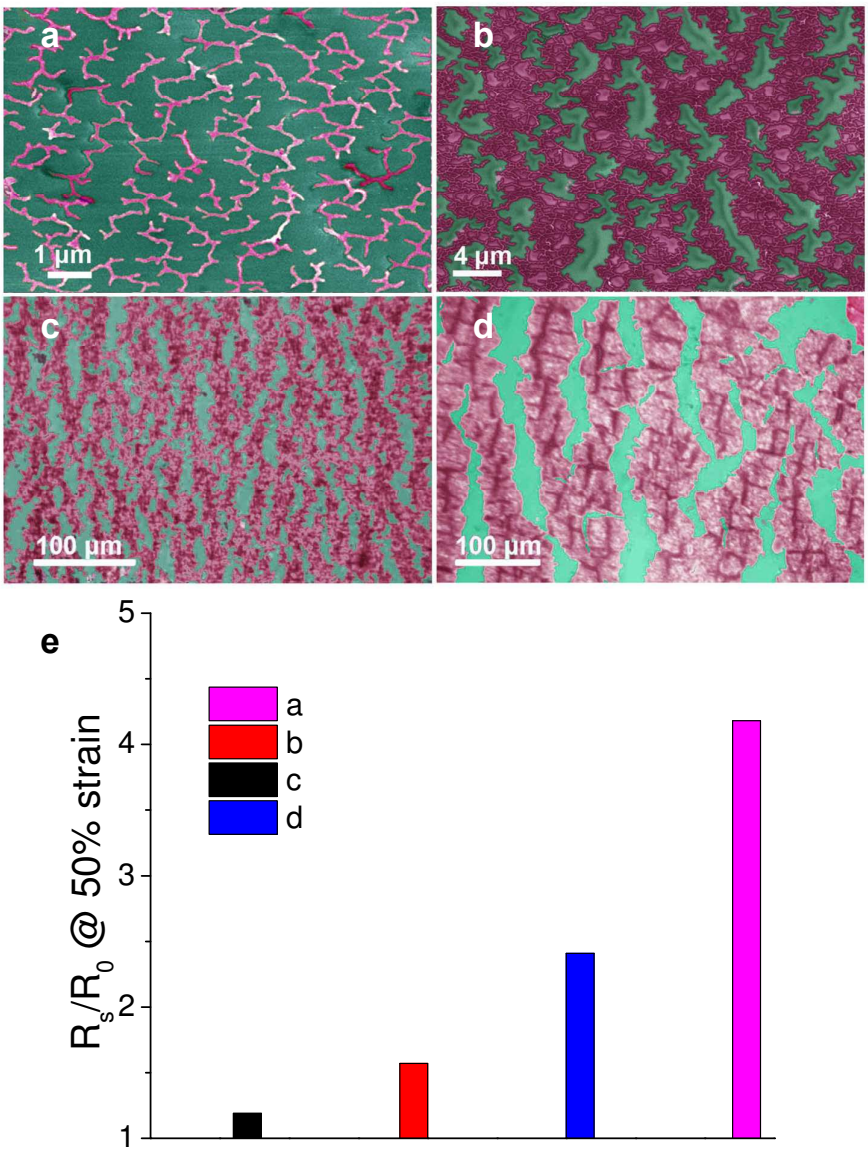


Figure S5. The rupture of AuNMes bonded on PDMS with different interactions: (a) chemical bond; (b) as-cured PDMS (van der Waals force); (c) ~10-nm-thick oil (PDMS base) on PDMS; (d) ~10-micron-thick oil on PDMS. The adhesion level decreases from (a) to (d) in sequence and the crack size increases as the adhesion decreases. (e) Normalized resistance as a function of strain for AuNMes at different adhesions.

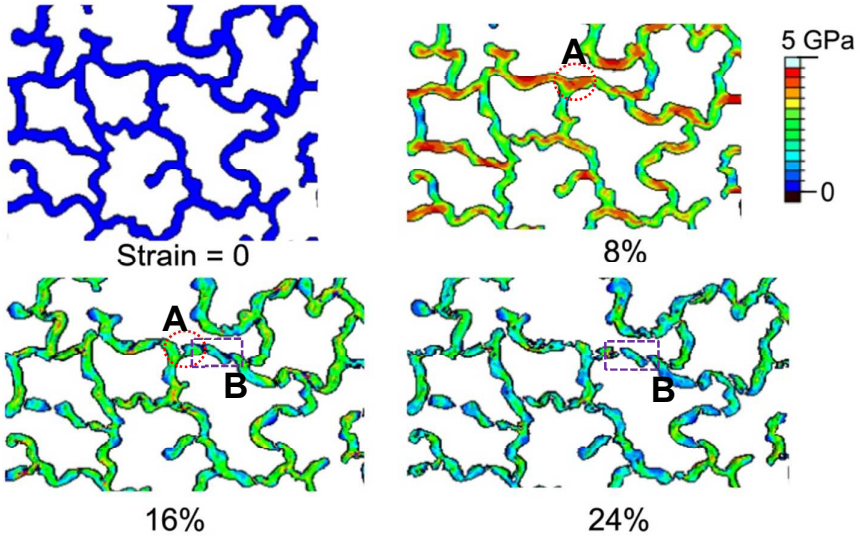


Figure S6. The stress distribution in a perfectly bonded AuNM at strains of 0%, 8%, 16%, and 24%.