SUPPLEMENTARY FIGURES TO MANUSCRIPT:
Ultrahigh Strength and Shear-Assisted Decohesion of Sliding Silver Nanocontacts Studied *in situ*

Similar experiments were performed for six trials in total. Each experiment led to a different contact width.

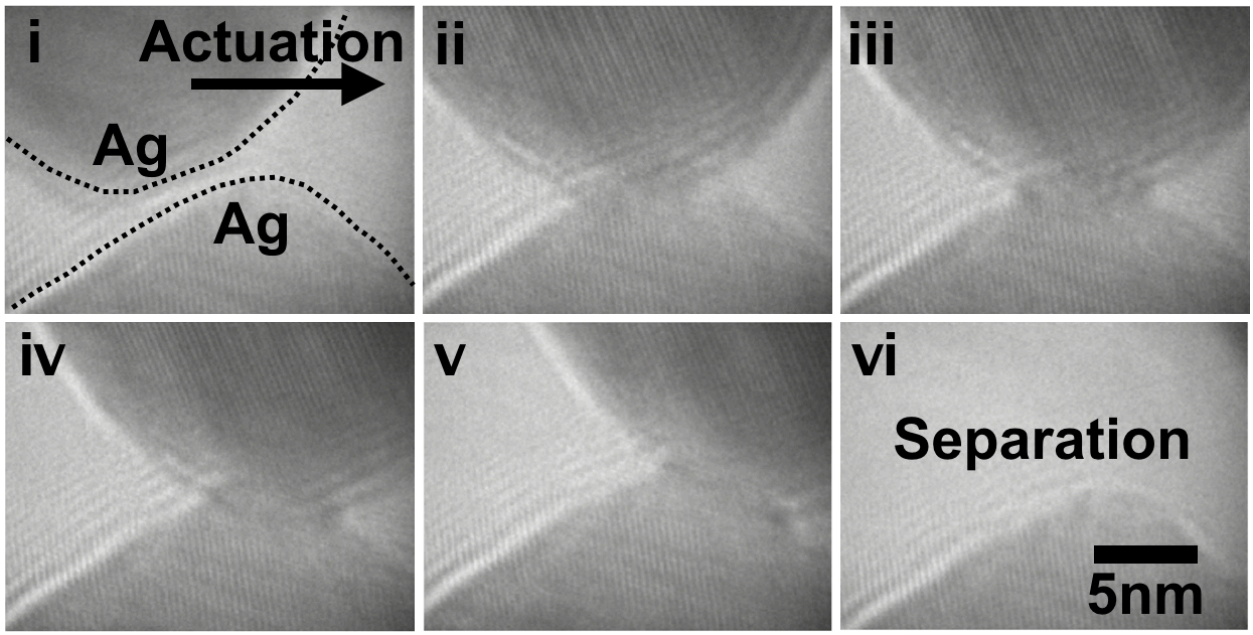

Figure S.1 | Shearing of single nano-asperity contacts observed by TEM. The upper tips was actuated in the lateral direction. ii, Two opposing tips were brought into contact. iii, iv, v, The upper tip was drugged across the other tips. vi, the junction was separated.

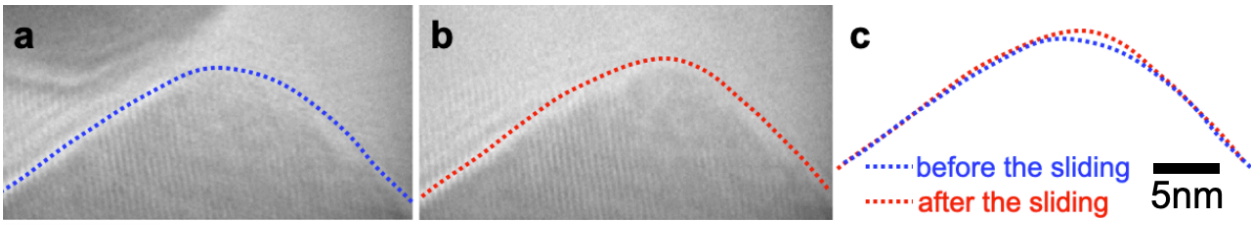

Figure S.2 | TEM images demonstrate that nanoscale plastic deformation occurred due to contact and separation. The shape before the contact as shown in **a** was compared with the shape after the separation as shown in **b**. **c** depicted the difference. TEM experiment demonstrated that the angular asperity rounded after the contact separation.

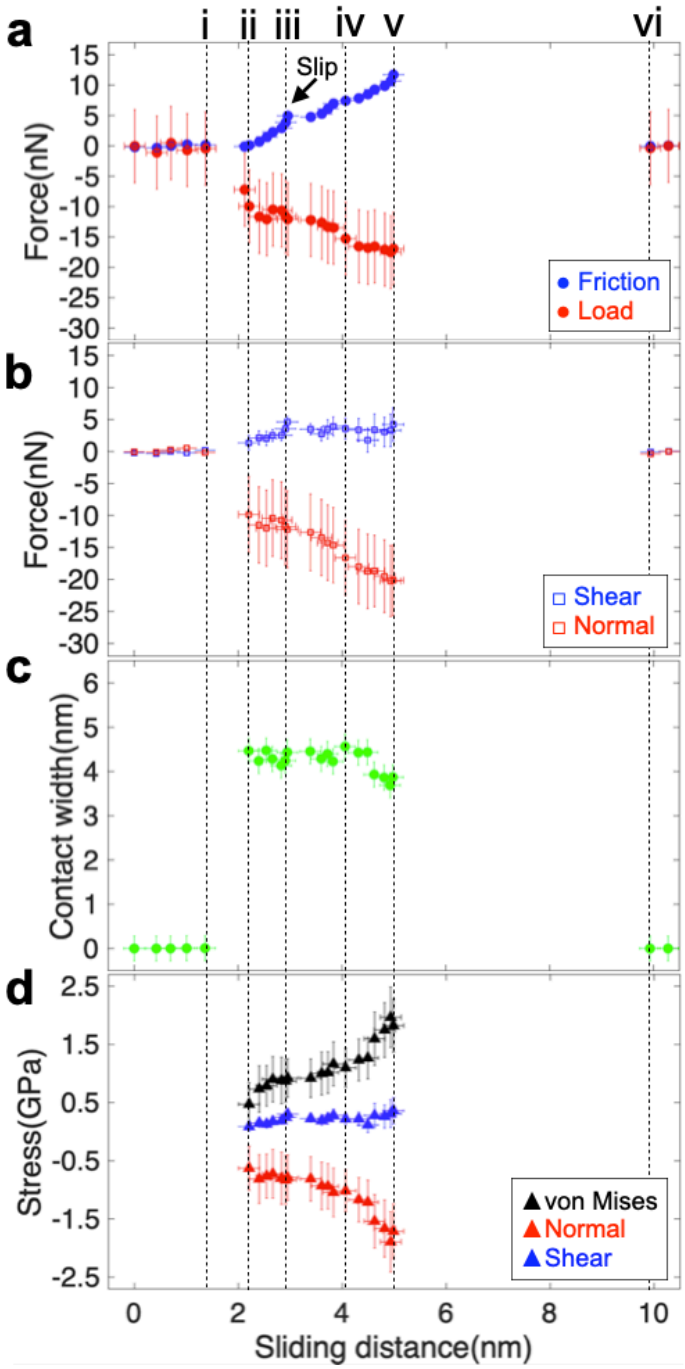

Figure S.3 | Forces (from the NEMS device), contact width (from TEM images), and resulting calculated stresses as a function of sliding distance. a, Friction force and load are plotted. **b,** The shear forces and normal forces are plotted. **c,** the contact width was measured as the shortest length of the junction. **d,** The von Mises stress and the normal stress were plotted. i-vi in the graph of **a-d** corresponds to i-vi in fig.S.1.

Another experiment was performed with different actual contact area.

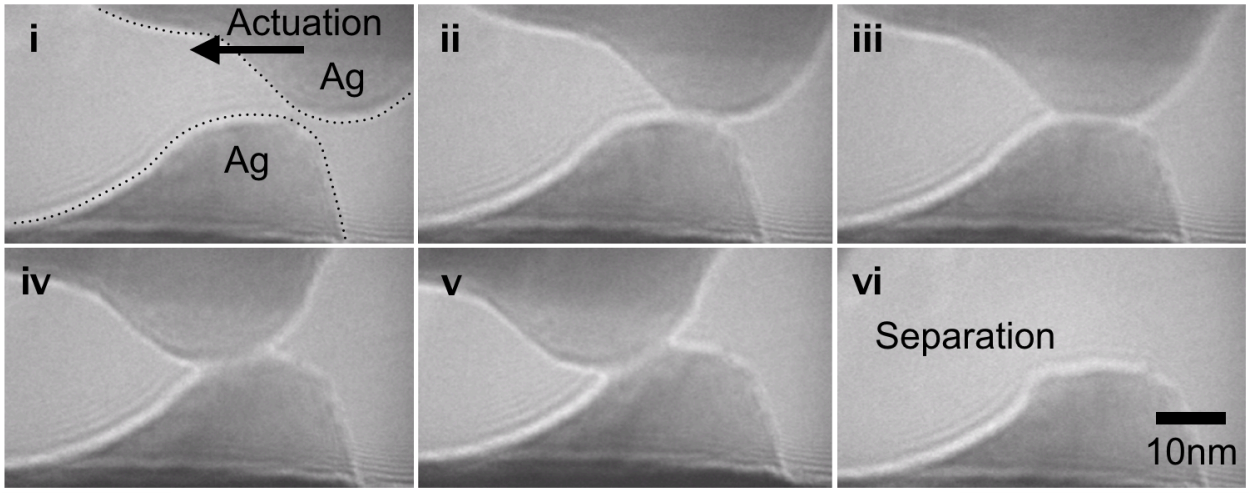

Figure S.4 | Shearing of single nano-asperity contacts observed by TEM. i, The upper tips was actuated in the lateral direction. ii, Two opposing tips were brought into contact. iii, iv, v, The upper tip was dragged across the other tips. vi, the junction was separated.

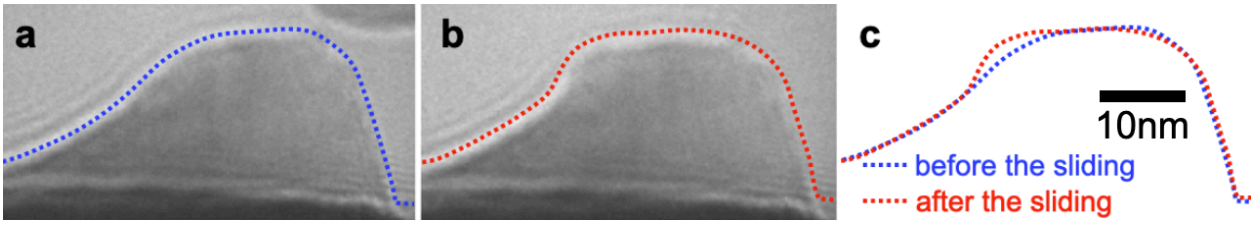

Figure S.5 | TEM images demonstrate that nanoscale plastic deformation occurred due to contact and separation.

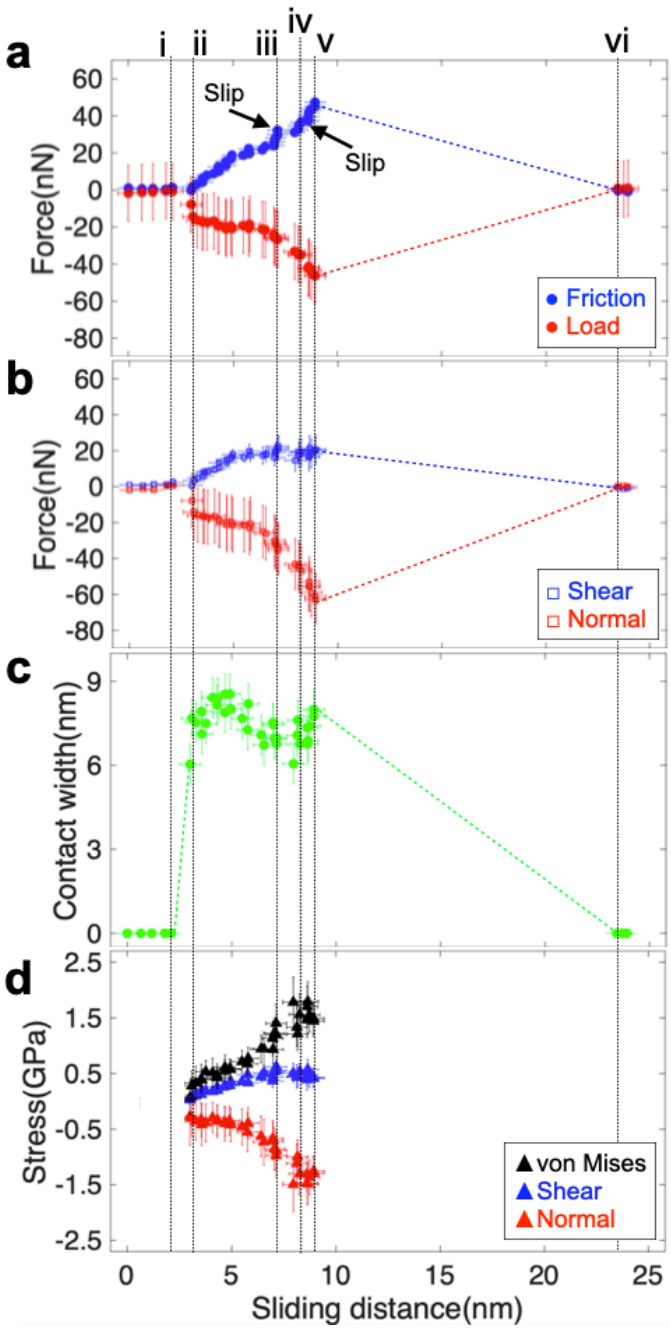

Figure S.6 | Forces (from the NEMS device), contact width (from TEM images), and resulting calculated stresses as a function of sliding distance. a, Friction force and load are plotted. **b,** The shear forces and normal forces are plotted. **c,** the contact width was measured as the shortest length of the junction. **d,** The von Mises stress and the normal stress were plotted. i-vi in the graph of **a-d** corresponds to i-vi in fig.S.4.

Another experiment was performed with different actual contact area.

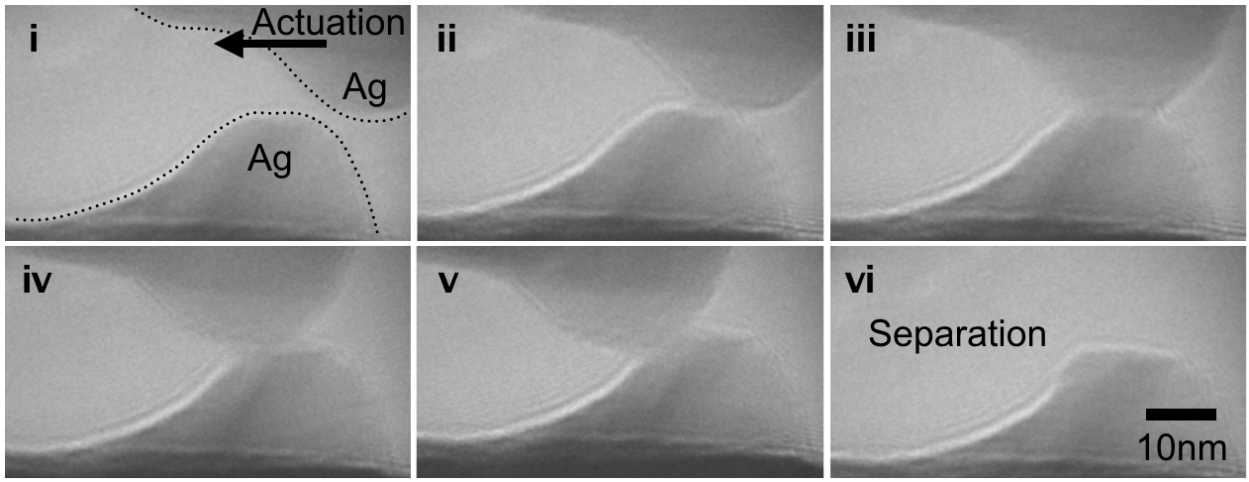

Figure S.7 | Shearing of single nano-asperity contacts observed by TEM. The upper tips was actuated in the lateral direction. ii, Two opposing tips were brought into contact. iii, iv, v, The upper tip was drugged across the other tips. vi, the junction was separated.

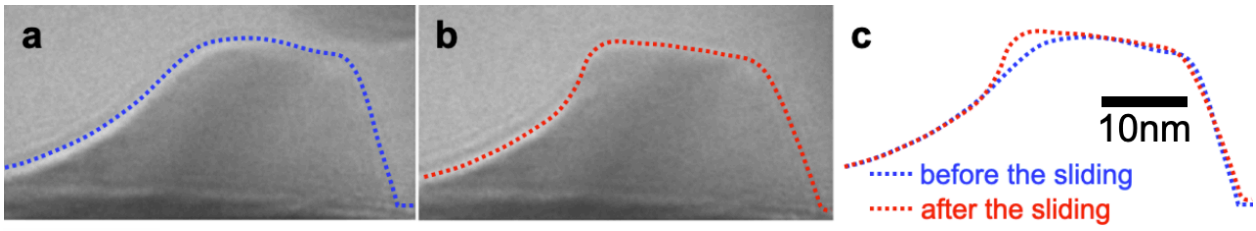

Figure S.8 | TEM images demonstrate that nanoscale plastic deformation occurred due to contact and separation.

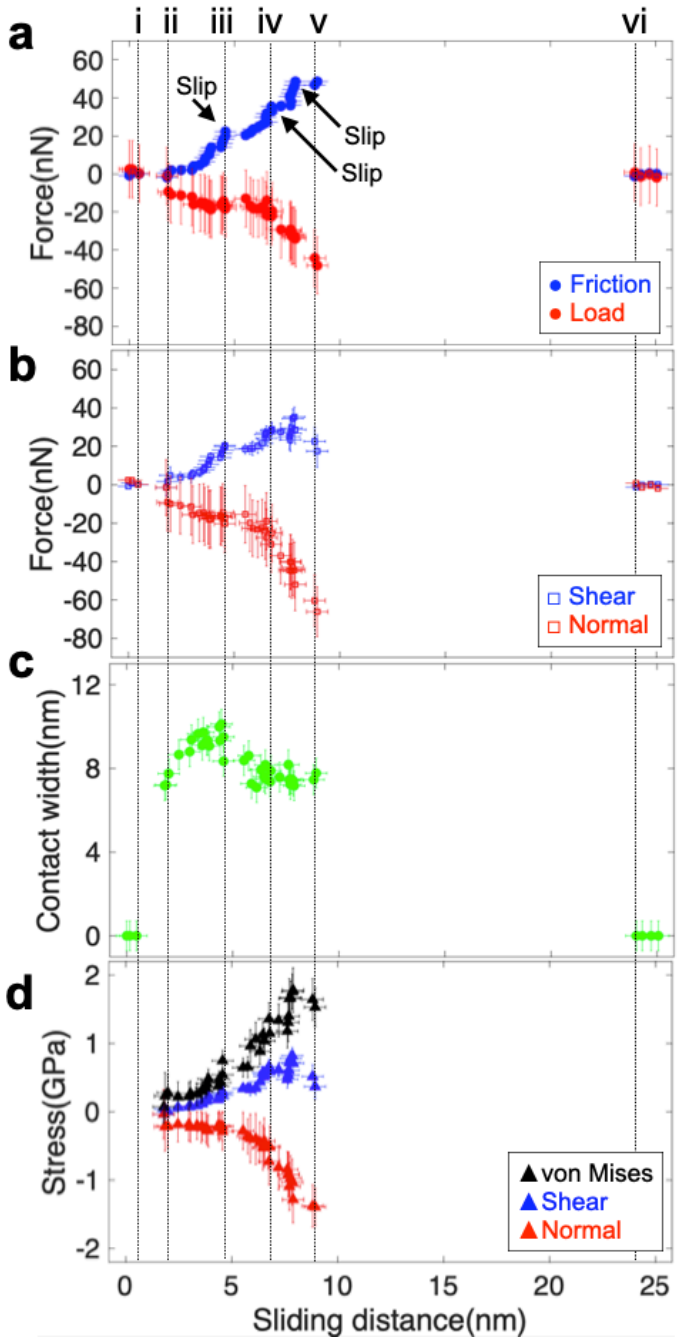

Figure S.9 | Forces (from the NEMS device), contact width (from TEM images), and resulting calculated stresses as a function of sliding distance. a, Friction force and load are plotted. **b,** The shear forces and normal forces are plotted. **c,** the contact width was measured as the shortest length of the junction. **d,** The von Mises stress and the normal stress were plotted. i-vi in the graph of **a-d** corresponds to i-vi in fig. S.7.

Another experiment was performed with different actual contact area.

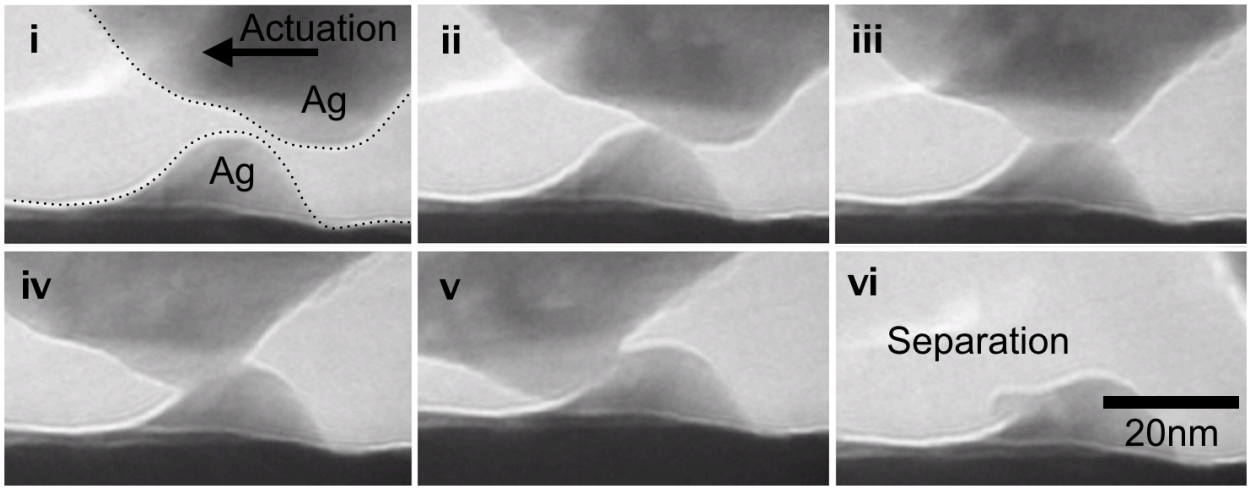

Figure S.10 | Shearing of single nano-asperity contacts observed by TEM. The upper tips was actuated in the lateral direction. ii, Two opposing tips were brought into contact. iii, iv, v, The upper tip was drugged across the other tips. vi, the junction was separated.

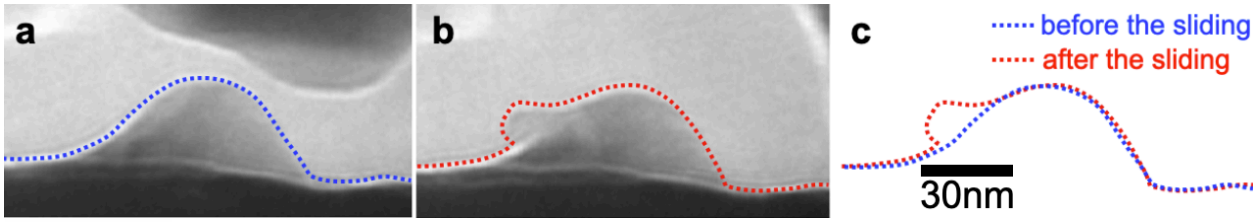

Figure S.11 | TEM images demonstrate that nanoscale plastic deformation occurred due to contact and separation.

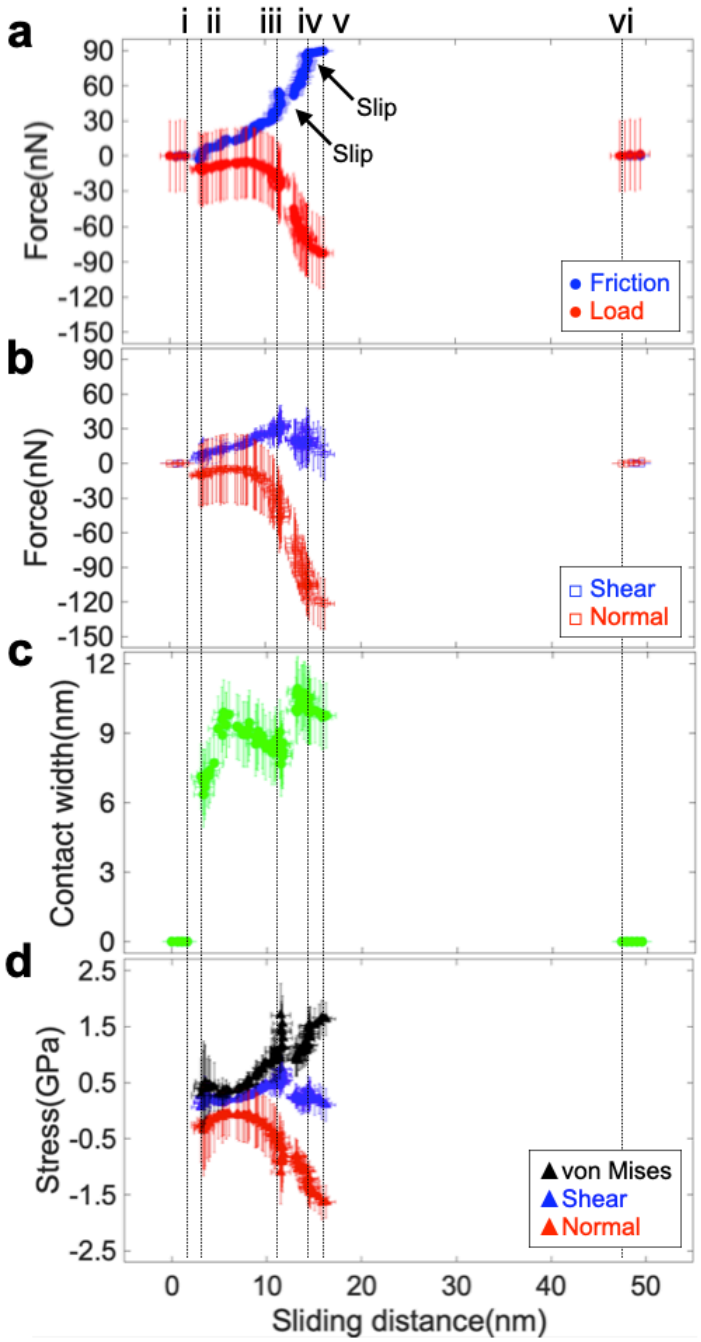

Figure S.12 | Forces (from the NEMS device), contact width (from TEM images), and resulting calculated stresses as a function of sliding distance. a, Friction force and load are plotted. **b,** The shear forces and normal forces are plotted. **c,** the contact width was measured as the shortest length of the junction. **d,** The von Mises stress and the normal stress were plotted. i-vi in the graph of **a-d** corresponds to i-vi in fig. S.10.

Another experiment was performed that was different actual contact area.

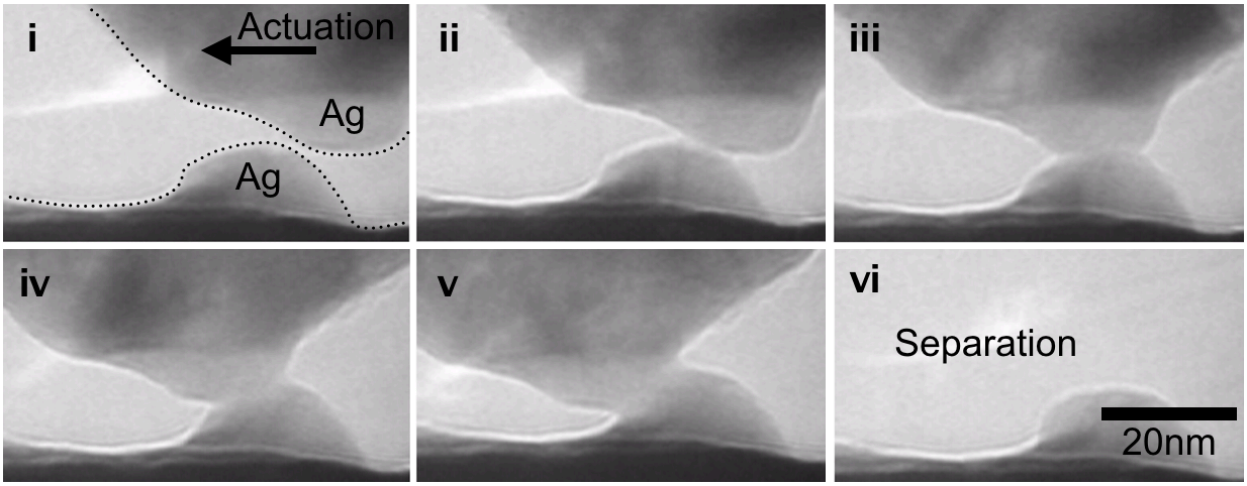

Figure S.13 | Shearing of single nano-asperity contacts observed by TEM. The upper tips was actuated in the lateral direction. ii, Two opposing tips were brought into contact. iii, iv, v, The upper tip was drugged across the other tips. vi, the junction was separated.

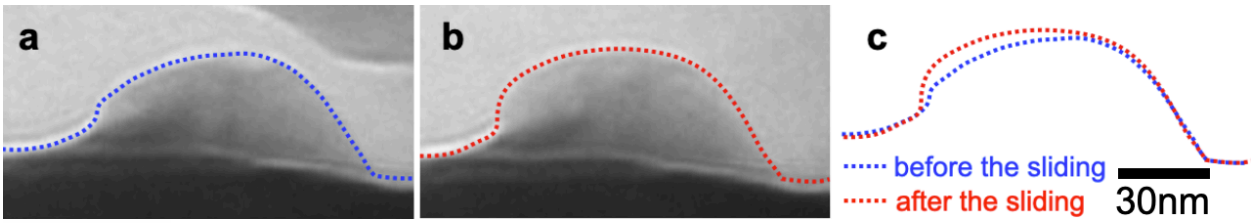

Figure S.14 | TEM images demonstrate that nanoscale plastic deformation occurred due to contact and separation.

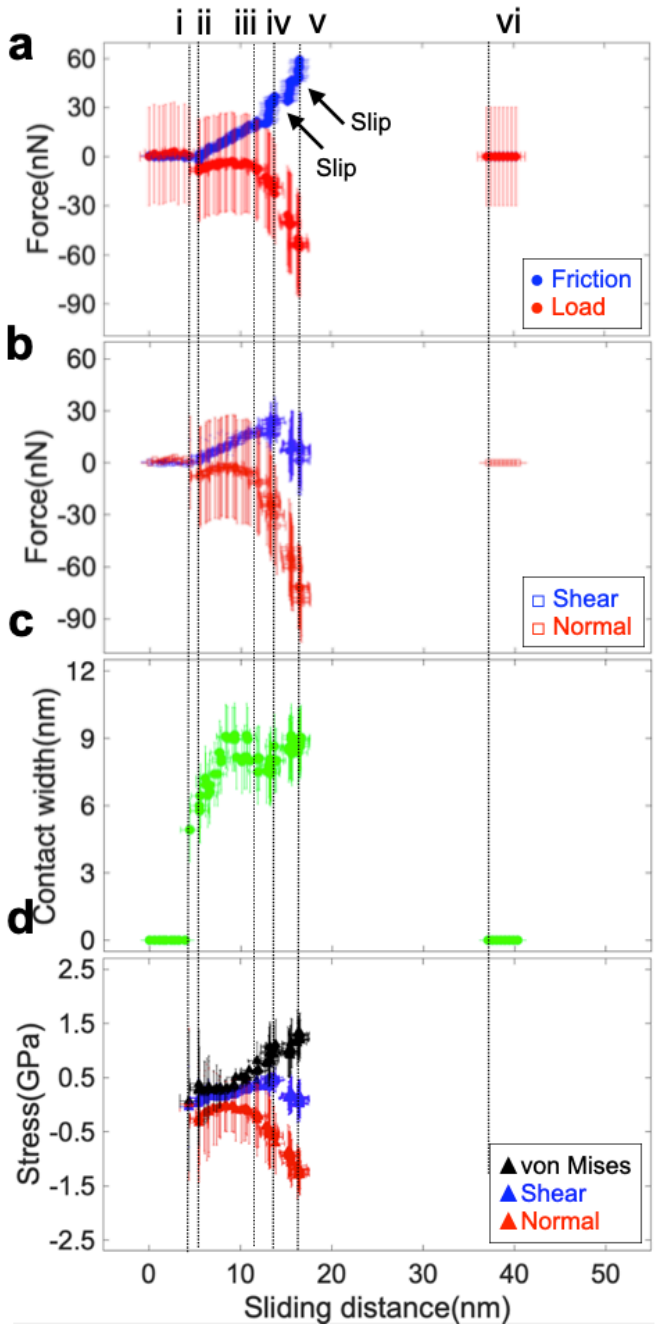

Figure S.15 | Forces (from the NEMS device), contact width (from TEM images), and resulting calculated stresses as a function of sliding distance. a, Friction force and load are plotted. **b,** The shear forces and normal forces are plotted. **c,** the contact width was measured as the shortest length of the junction. **d,** The von Mises stress and the normal stress were plotted. i-vi in the graph of **a-d** corresponds to i-vi in fig. S.13.