ADVANCED FUNCTIONAL MATERIALS

Supporting Information

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In Situ Observation Reveals Local Detachment Mechanisms and Suction Effects in Micropatterned Adhesives

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1. Influence of the retraction velocity

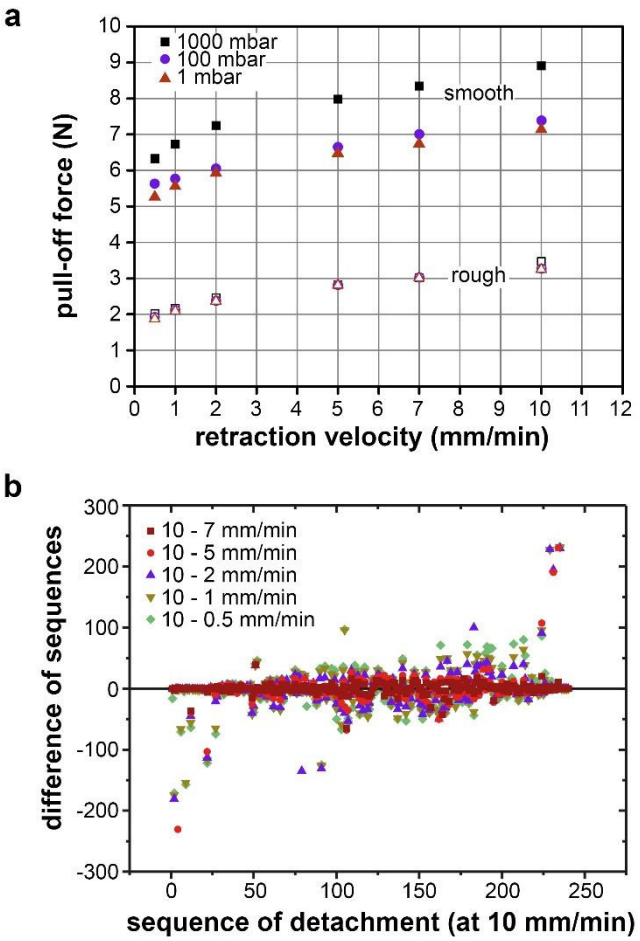

Figure S1. Pull-off force as a function of retraction velocity and air pressure. (a) Variation of the pull-off force with retraction velocity for the smooth (filled symbols) and rough (open symbols) specimen at various air pressures. **(b)** Variation in the sequence of detachment in terms of the retraction velocity for the smooth specimen at atmospheric pressure. The difference of the sequence of pillar detachment is calculated by substracting sequences obtained for various velocities from the sequence of detachment obtained for 10 mm/min.

Figure S1a shows the influence of the retraction speed on the pull-off force at different air pressures. As a general trend, adhesion forces increased with increasing retraction velocities from 0.5 to 10 mm/min. In particular, the pull-off force increased by about 29 and 42% for the smooth and rough specimen, respectively. This rate dependence is most likely related to the viscoelasticity of the polydimethylsiloxane with viscoelastic loss factors, $\tan\delta$, between 0.1 and 0.15 for strain rates from 1 to 100 s^{-1}.(1,2) The rate dependence of the detachment of viscoelastic pillars is then controlled more by high crack propagation speeds in the order of mm/s than by the much lower retraction velocities in the order of mm/min, in line with previous reports.(3) Interestingly, the rate dependence was insensitive to air pressure, indicating that diffusion of air into cavities formed by center cracks can be neglected on the time scale of crack growth.

Differences in the detachment sequence of individual pillars for varying retraction velocities is exemplarily shown for the smooth specimen at atmospheric pressure in **Figure S1b**. The similarity of the sequence of pillar detachment was quantified: the indices obtained for the various retraction velocities were subtracted from the sequence obtained for 10 mm/min. The standard deviation increased from 0.04 to 0.17 with larger differences in the retraction velocity.

2. Repetitive measurements

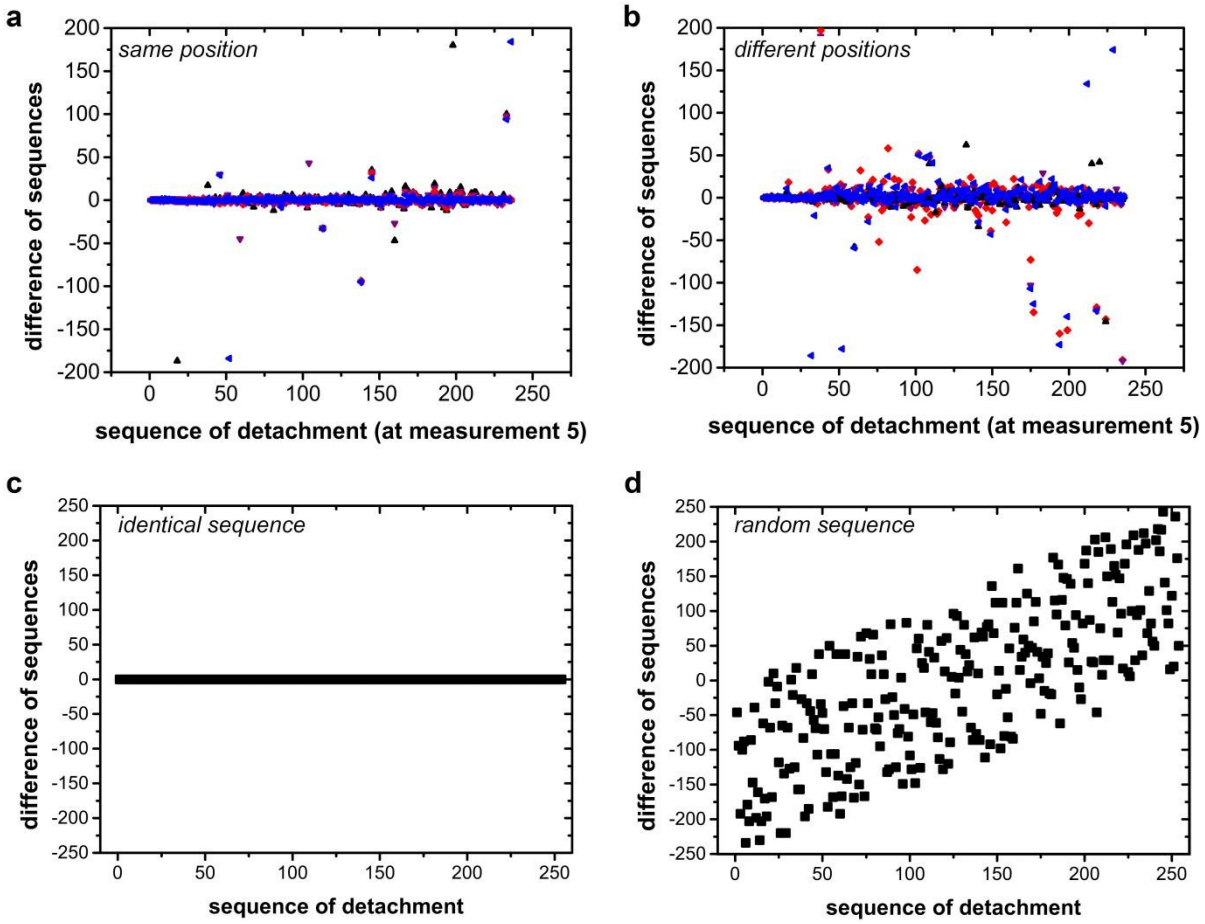

Figure S2. Comparison of the sequence of detachment for measurements at the same and different positions. (a) Differences of the sequence of detachment for five different measurements performed at the same position. **(b)** Differences of the sequence of detachment for five different measurements performed at five different positions. **(c)** Limiting case (theoretical) for identical sequences. **(d)** Limiting case (theoretical) for a random sequence of detachment.

References

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