Electronic Supplementary Material (ESI) for Soft Matter.

S1. Comparison of the results of adhesion experiments on differently treated glass with those on Teflon. Characterization of test surfaces (water contact angle and mean roughness).

Material and Methods

Attachment disks of adult female Nephila senegalensis were harvested as described in the main manuscript. Tensile tests were performed as described in the main manuscript and Grawe et al., 2014.

Contact angle of silan-treated and untreated glass slides was measured with DataPhysics OCA 20 (DataPhysics Instruments GmbH, Filderstadt, Germany) using 500 µl droplets of aqua bi-dest.

Surface roughness was measured by means of Atomic force microscopy (AFM Typ NanoWizard, JPK Instruments AG, Berlin, Germany). The imaging and the force mapping was done with a Contact Cantilever (CONT, NanoWorld AG, Neuchâtel, Switzerland, resonance frequency 13 kHz, force constant 0.1862 N m-1). To characterize the scanning tip geometry the cantilever scanned a mica disk with colloidal gold particles (5.5, 9.3, 14.4 nm) (Pelco AFM Gold standard Kit Product No. 16205, TED Pella, Inc, Redding, CA). With the scanning probe image processing software (SPIP, Version 5.1.2, Image Metrology A/S, Hørsholm, Danemark) the radius (11 nm) was determied via blind tip reconstruction. Root mean squared surface roughness (RMS) was calculated with SPIP from 5x5 µm (glass slide) or 35x35 µm (PTFE foil) scans.

Results and Discussion

The PTFE foil used in previously published experiments (Grawe et al., 2014) exhibits a similar water contact angle like glass slides treated with DMDCS vapour.

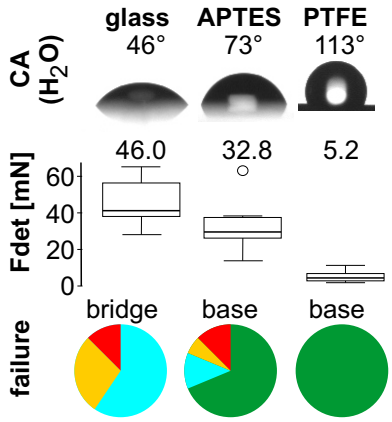
The attachment forces of attachment discs spun on Teflon are significantly lower than on untreated and APTES treated glass, but still sufficient to hold the body weight of the spider.

The dicrepancy with the results obtained on DMDCS treated glass (no application of attachment disc possible on this surface) might be explained by the difference in surface roughness.

The PTFE foil exhibits a nano roughness, which may highly increase the contact area between the pyriform glue and the substrate. This is only possible if the pyriform glue has a low viscosity and surface tension in the moment of application.

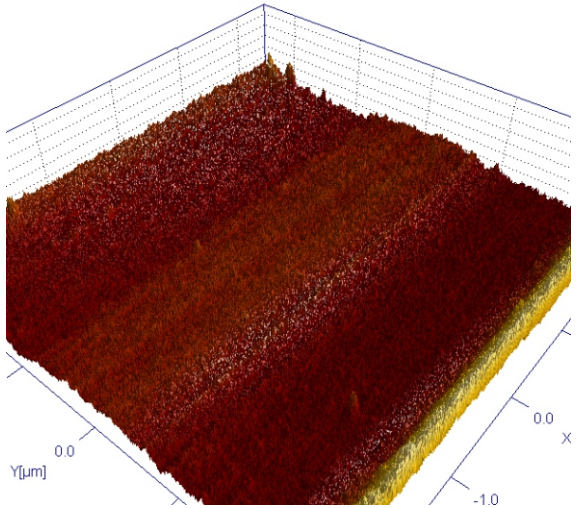
References

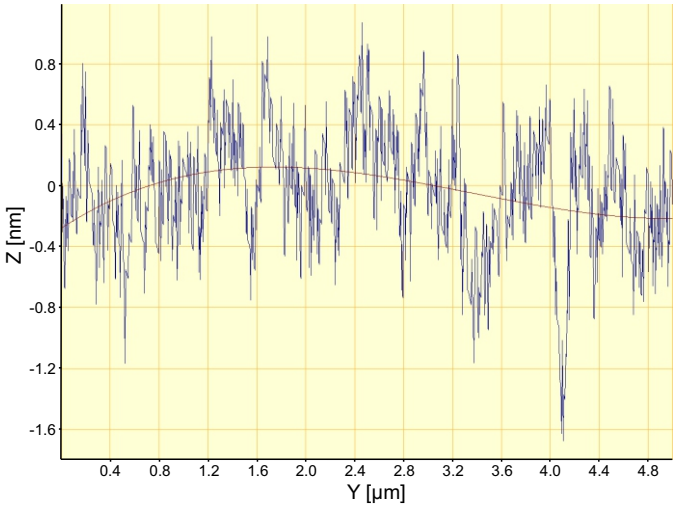
Grawe, I., Wolff, J. O. & Gorb, S. N. 2014. Composition and substrate-dependent strength of the silken attachment discs in spiders. *J. R. Soc. Interface* 11, 1742-5662



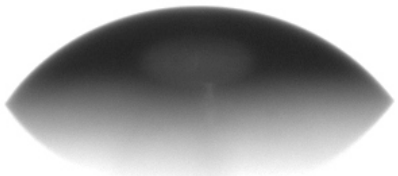
Results of tensile tests of N. senegalensis attachment discs spun on untreated, silan-treated glass and PTFE (Teflon) foil resulted in different detachment forces and failure modes. Above, the contact angle (CA) measurement of water droplets on the substrates demonstrates their differences in hydrophilicity. Box plots give the median and variance of detachment force (Fdet) data. Numbers above box plots give the mean values (in brackets number of individuals tested). Pie charts in the bottom indicate the proportion of failure modes, whereby red symbolizes dragline failure, yellow conjunction failure, blue bridge failure and green baseplate failure (total delamination) (for details see Grawe et al., 2014)

Glass slide untreated



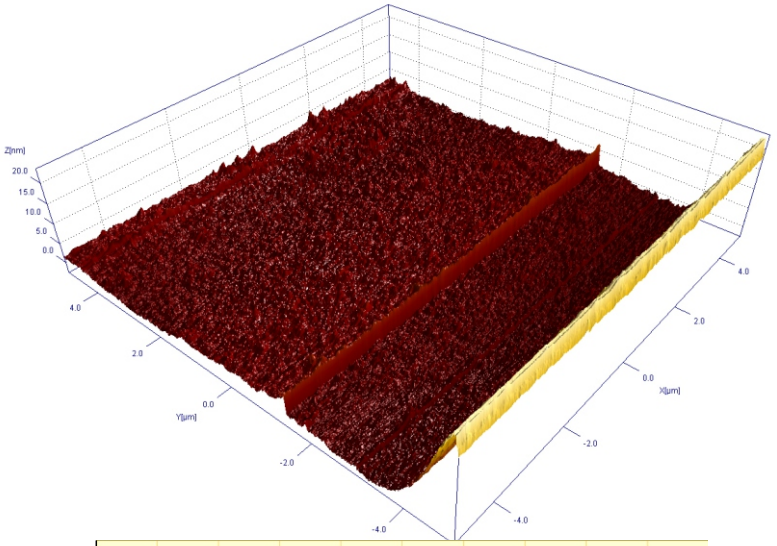


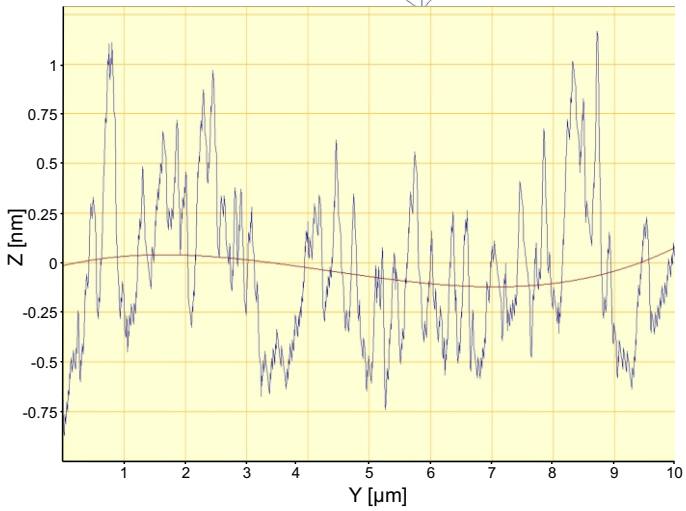
RMS 2.5 nm



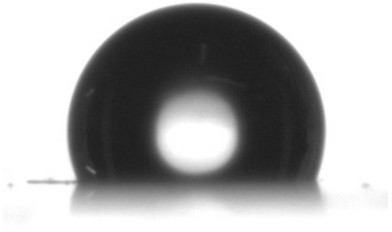
Mean CA 46°

Glass slide DMDCS treated



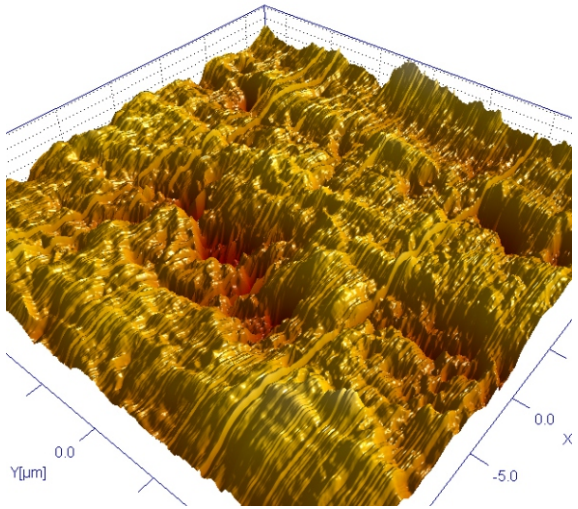


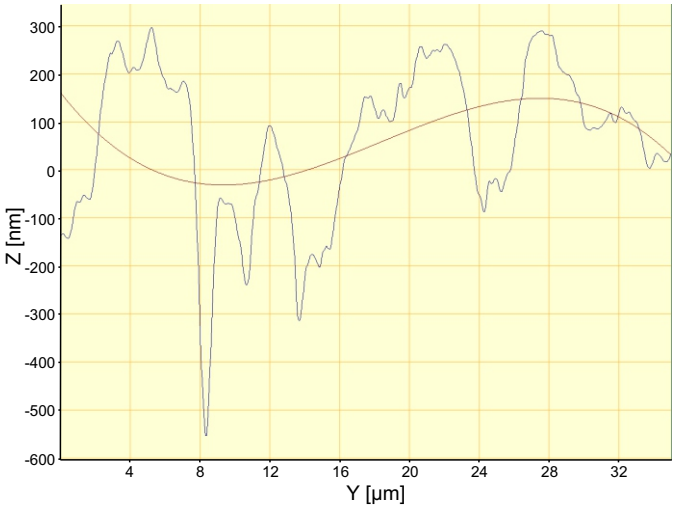
RMS 4.7 nm



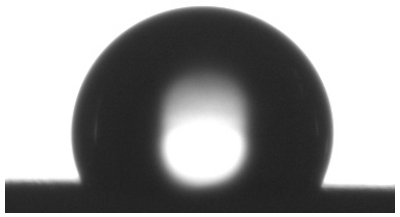
Mean CA 114 °

PTFE Foil





RMS 222.3 nm



Mean CA 113°