

Using a multi-camera system in which both the front and side angle of the peel front are observed allows for simultaneous viewing of how the adhesive and substrate interact with each other during testing. This will assist in developing a detailed understanding of soft substrate peel mechanics during peel such as if fluctuations in the data are correlated to slipping, or prolonged adhesion between the tape and the soft substrate.

This work is sponsored by Hollister Inc., Libertyville, IL.



Project Background

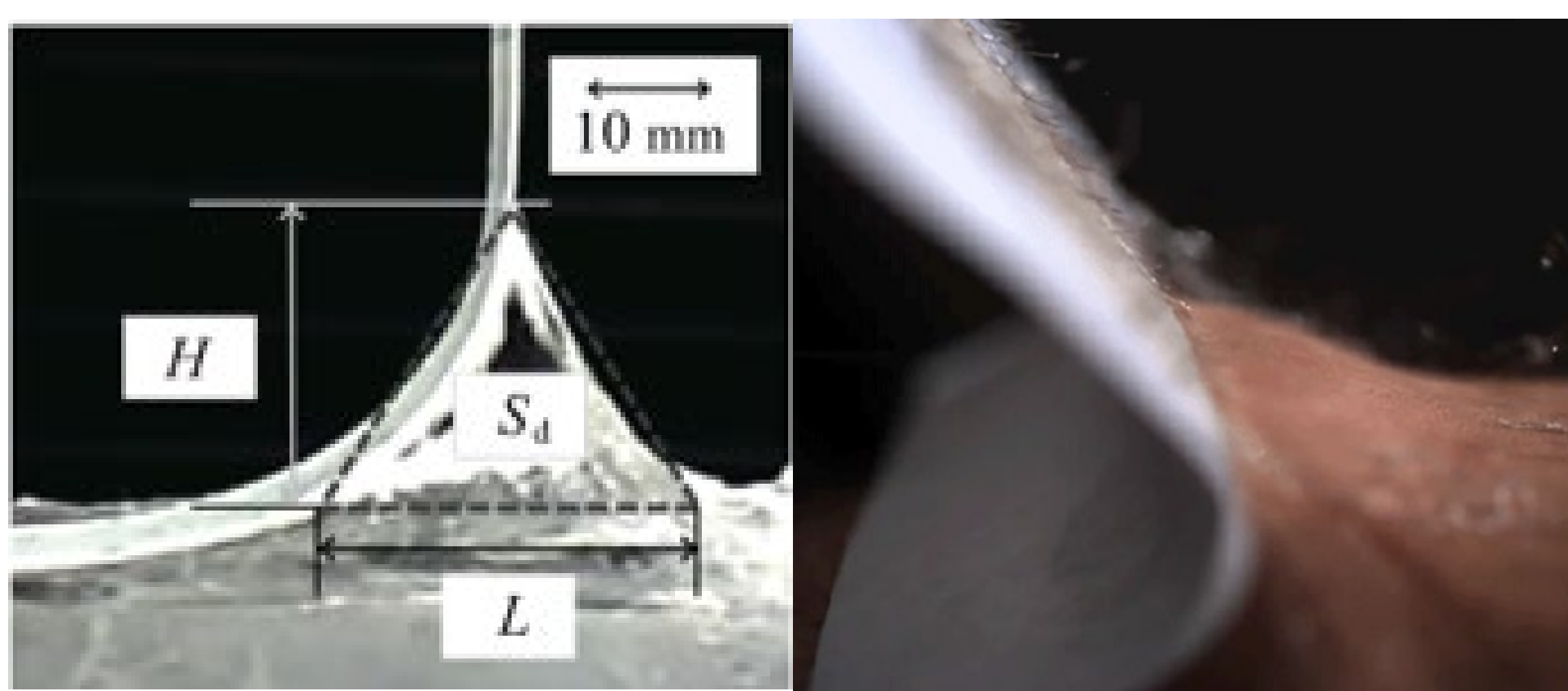
- Ostomy is a surgery in which a stoma is surgically created on a user's abdomen to bypass the digestive system, the urinary system, or both.
- An ostomy bag is adhered to the user's skin and used to collect the bodily waste.



- This project aims to grant a detailed understanding of soft substrate peel mechanics during peel.
- By recording video of medical tape as it is removed from a soft substrate, the mechanics behind the peel front can be highlighted.
- The peel front is the portion of the substrate that stays adhered to the tape during removal.
- The soft substrate used in this project has similar mechanical properties to mimic human skin.
- Understanding the mechanics behind soft substrate peel will assist Hollister in their goal to reduce skin irritation during the changing of ostomy bags.

$$\frac{P}{G_A} = \frac{1}{1 - \cos(\theta)}$$

P = peel force per width [N/m]
G_A = adhesion energy of the interface [J/m²]

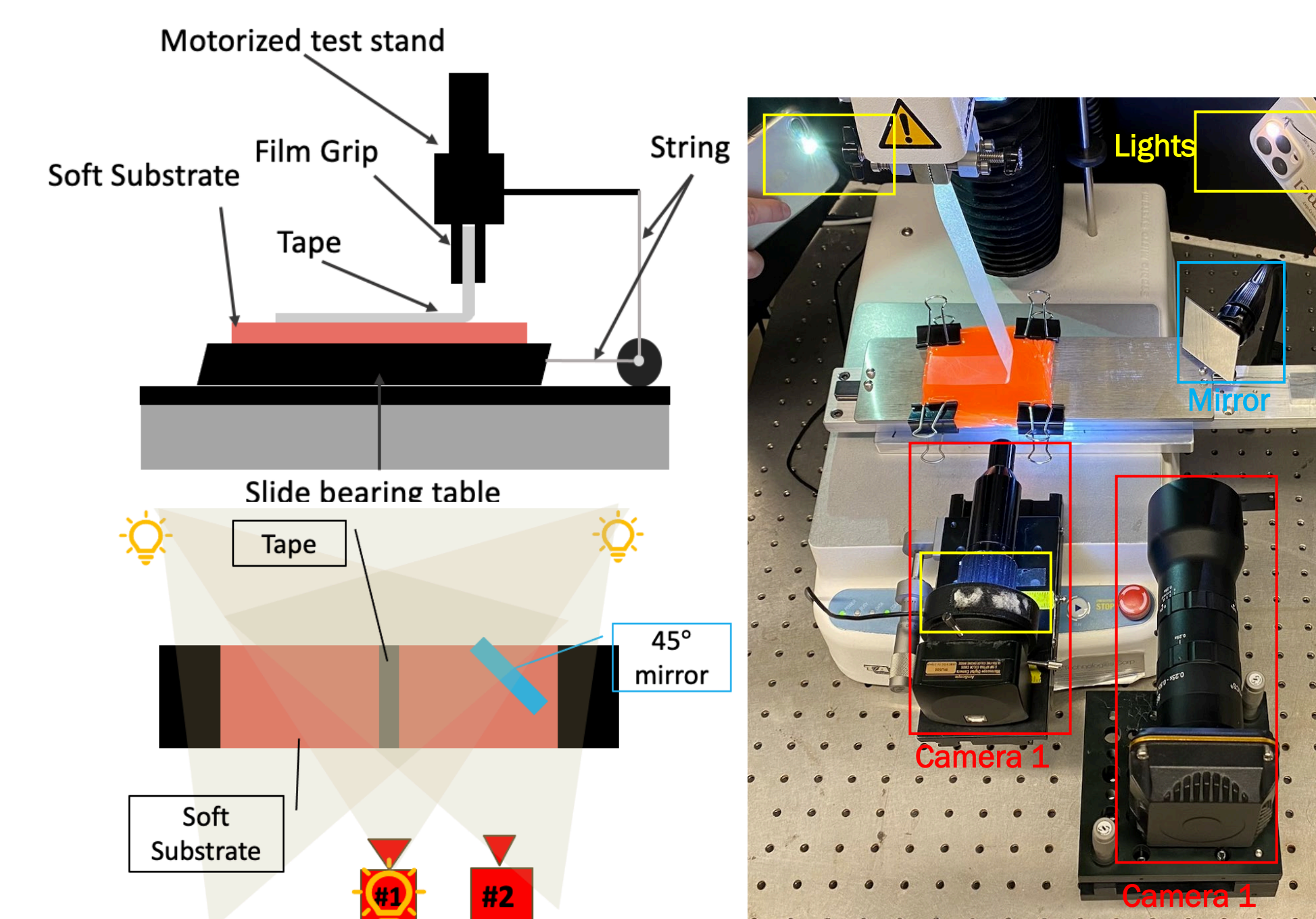


Y. Sugizaki, et al. (2016)

Experimental Setup

Test Method:

- The TA.XT Plus Texture Analyzer produced by Texture Technologies Corp. was used for 90° peel tests.

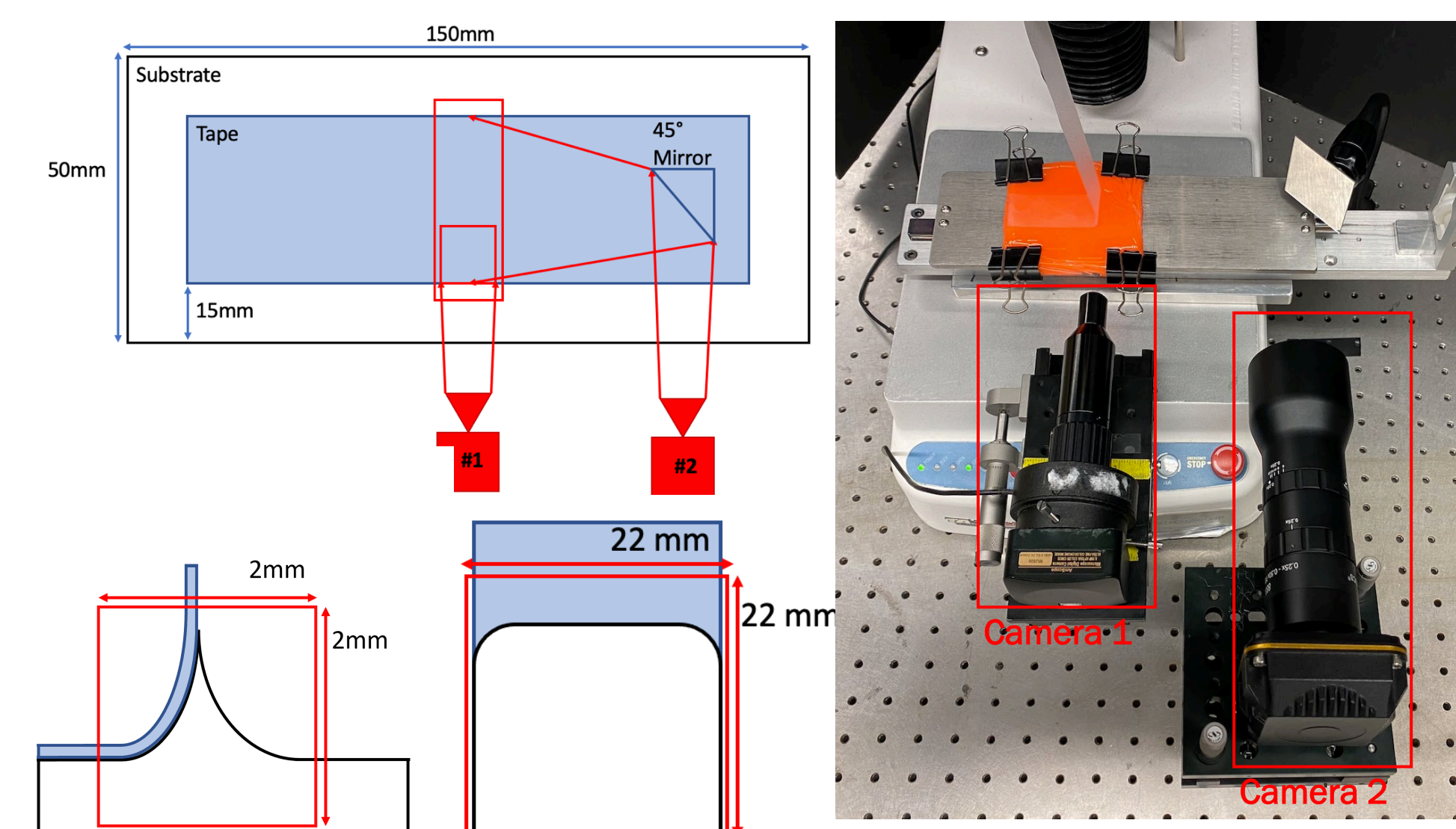


Multi-camera system:

- Two cameras placed in front of the peel tester.
- Three light sources to mitigate any shadows.
- Cameras were set on a linear stage.
- A 45° mirror stage is placed to provide the front's visibility from a 90° angle.
- Camera 1 (USB 3.1 Blackfly®) with lens (VariMagTL™ Telecentric Lens)
- Camera 2 (USB 3.1 Blackfly®) with lens (InfiniProbe Microscope (0-3.2X) S-32 Video)

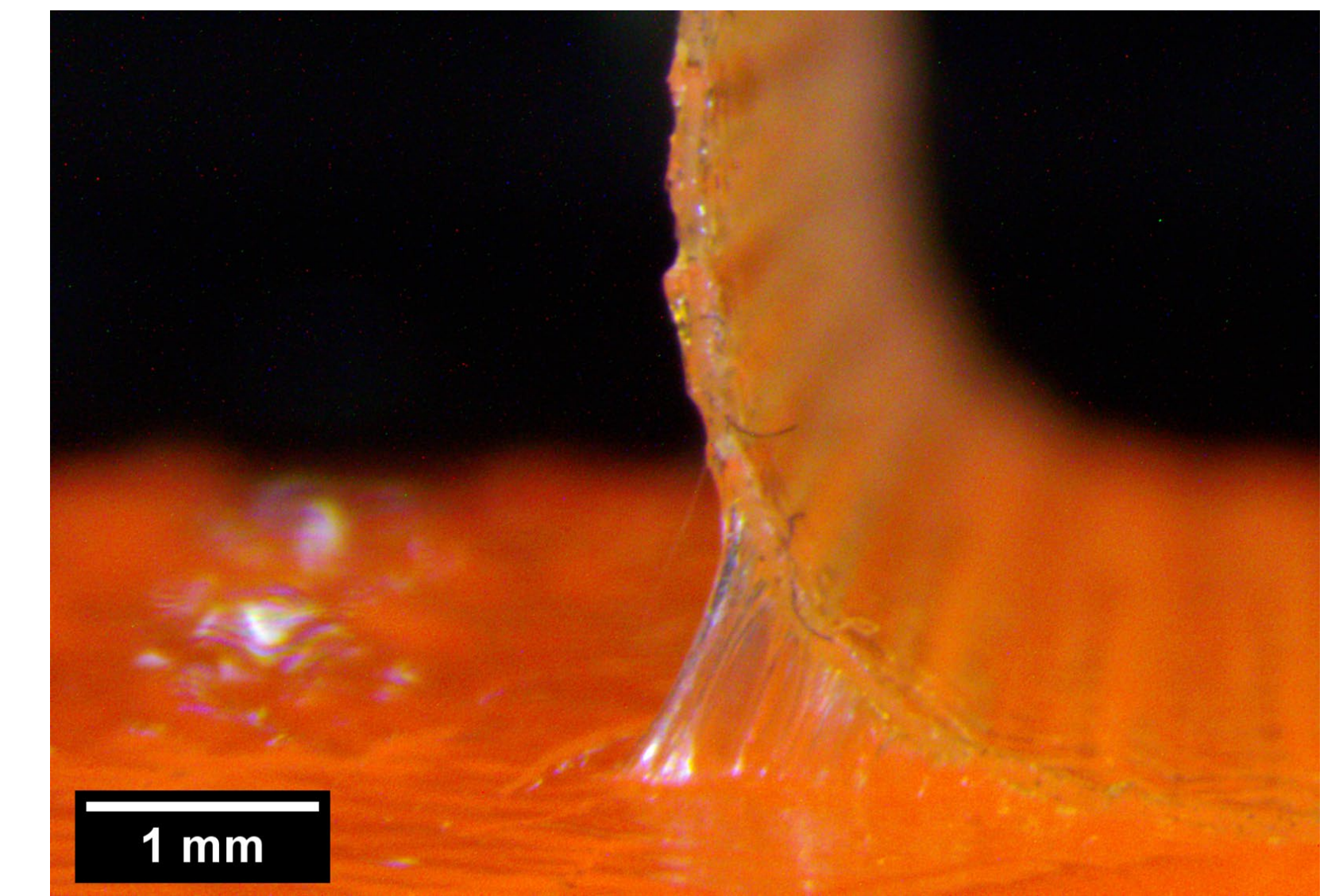
Peel zone dimensions:

- Camera 1 was set to focus on the front edge tape with a 2 by 2mm video dimension.
- Camera 2 was set to focus on the entire side peel front with a 22 by 22mm video dimensions.

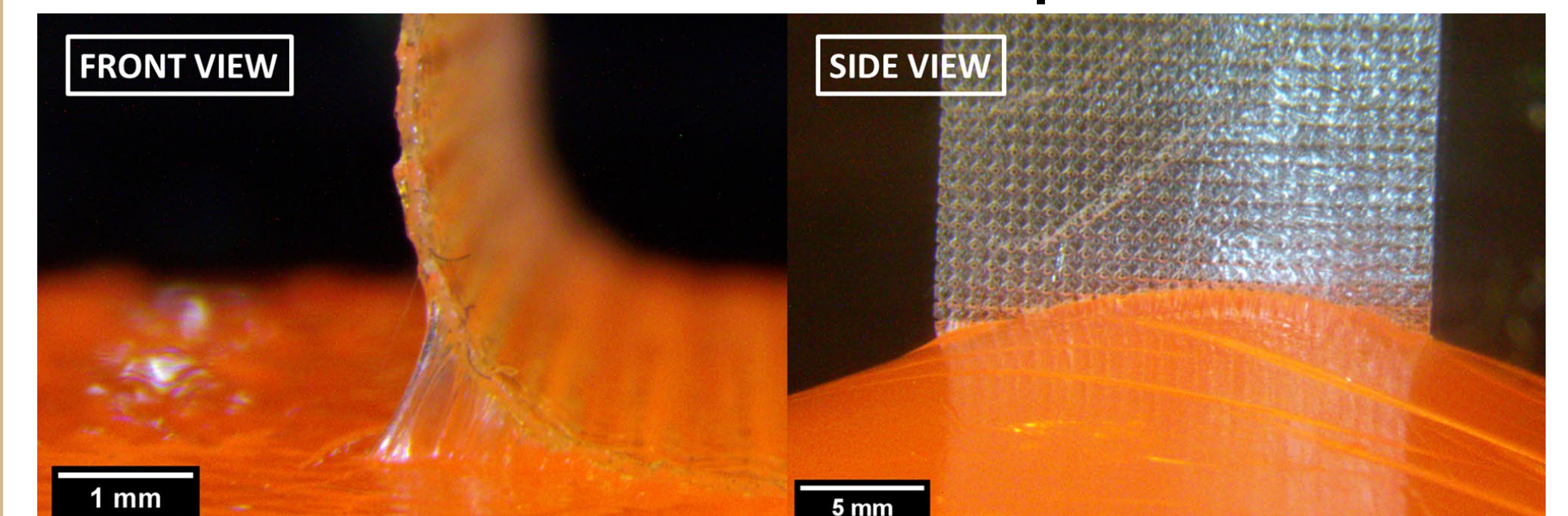


Results

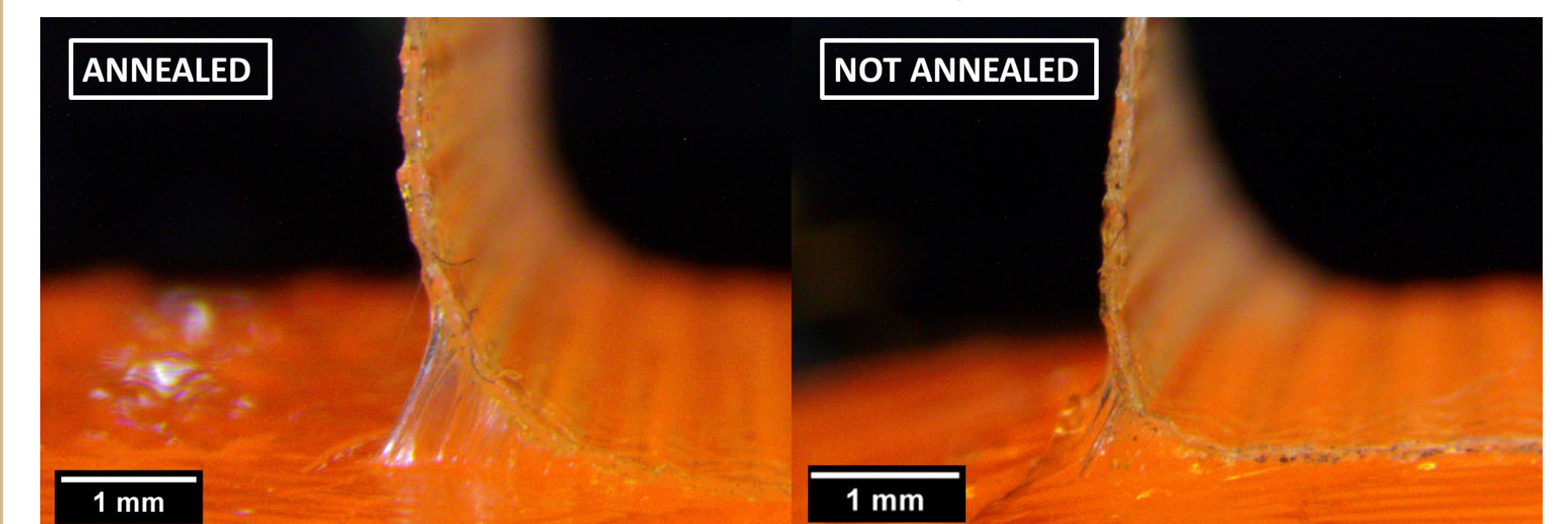
Peel test with annealed 20 kPa soft substrate



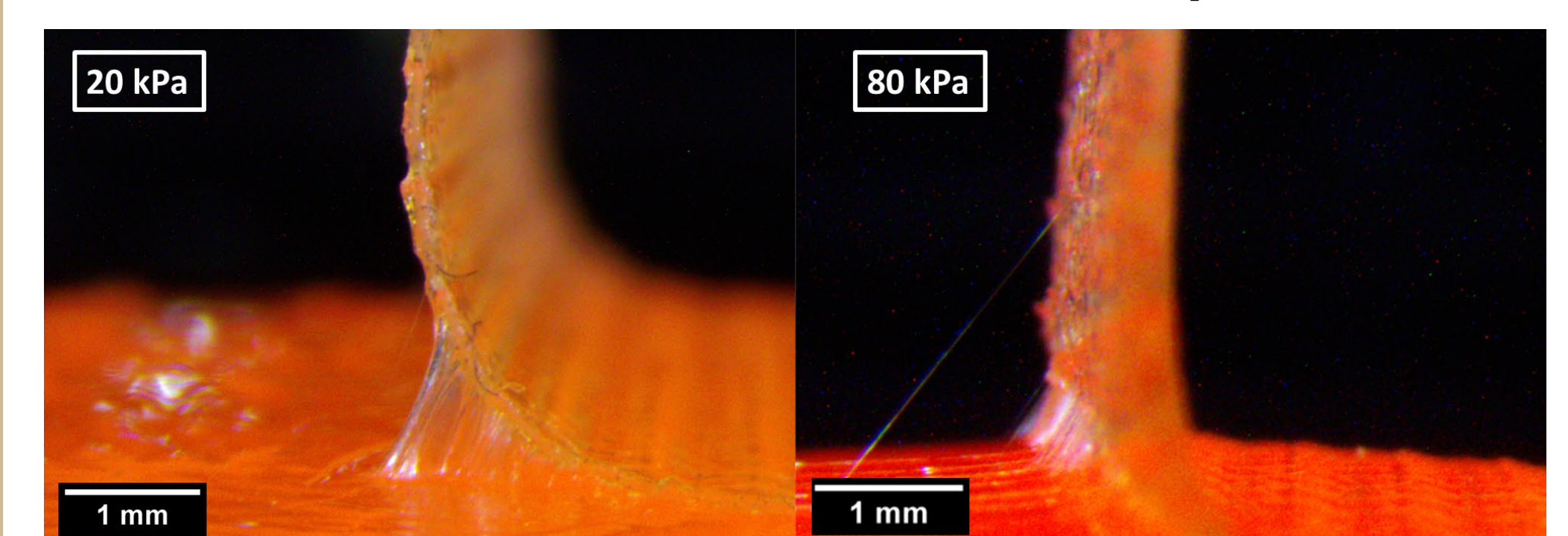
Front and side view comparison



Soft substrate annealing comparison

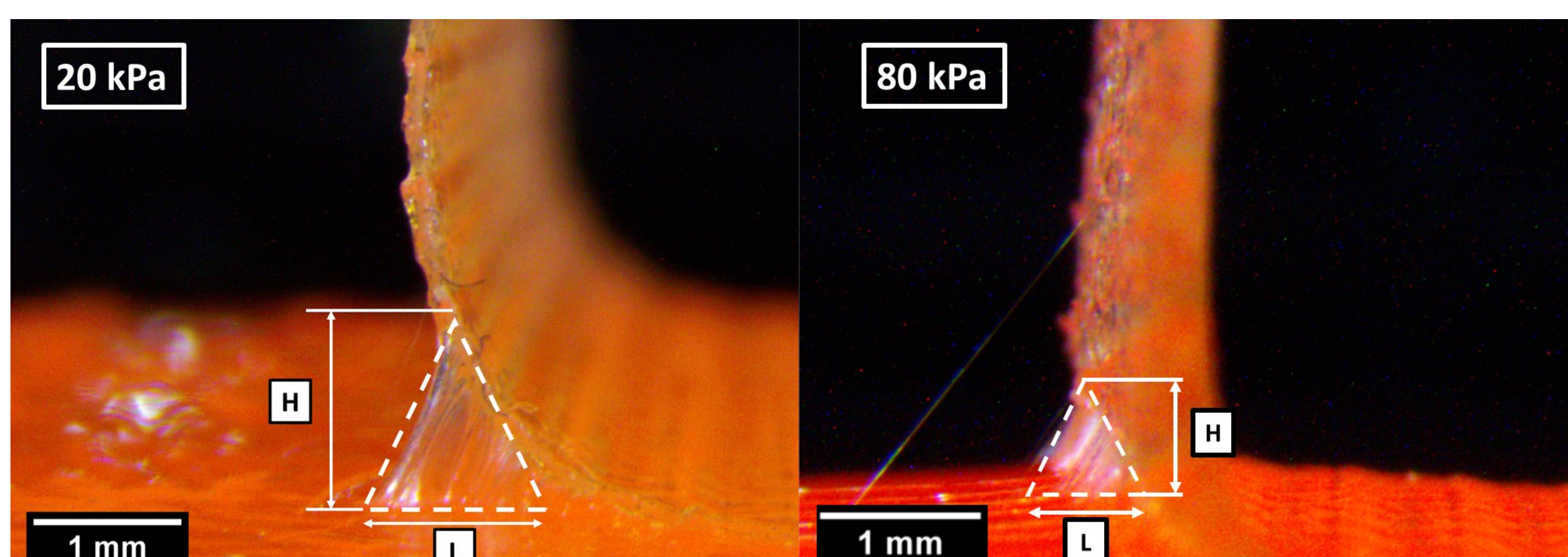


Soft substrate elastic modulus comparison



Discussion & Conclusions

- The front view and the side view images provide proof of concept for the experimental setup.
 - Allows for clear analysis of the interface.
- The adhesion between the surfaces increases when the sample is annealed.
 - Peeling at body temperature yields increased deformation.
- Peel front deformation decreases with increasing soft substrate elastic modulus.
 - Different skins yield different peel mechanics.



- Results allow for clear deformation analysis and proper understanding of the interacting between these two surfaces.

Future Work

- Creating a software to automatically analyze the soft substrate deformation that is seen in the captured images.
- The development of more skin-like soft substrates of a greater elastic modulus range.
- The development of more comfortable adhesives for all different skin types, as necessary.

Acknowledgments & References

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Without them, this project would not have been possible.