Electronic Supplementary Materials

for

Self-Assembled Thin Films as Alternative Surface Textures in Assistive Aids with Users Who are Blind

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S1. Roughness scaling

Power spectrum density (PSD). PSD was calculated of the fresh samples' atomic force microscopy (AFM) results. The PSD results (**Fig. S1**) were used to help analyze the difference in features present on the surface of each sample and the spatial distribution of their roughness.

Hurst exponent. The slope of the linear regime of PSD obtained from each sample's AFM was found and used to calculate the Hurst exponent of each surface as $H = 1 + 0.5 \times (|\text{slope}|)$. The resulting Hurst exponents allowed comparison of the samples' surface roughness scaling variation.

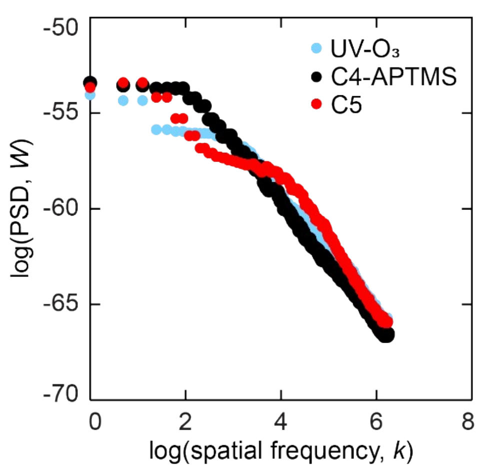

Figure S1. Power spectrum densities of fresh samples. PSD results for each of the three surfaces considered. The slope of the linear regime was used to calculate each sample's Hurst exponent.

S2. Materials characterization

Atomic force microscopy (AFM). AFM was performed on the samples worn by a human finger (**Fig. S2a**). The FFT of the topographies of samples (**Fig. S2b**) shows a more diffuse signal from the worn C4-APTMS surface than in its fresh state. This change in frequency space demonstrates a difference in roughness scaling behavior than present in fresh C4-APTMS. The FFT of the worn C5 sample produces a stronger signal at its center, also indicating a difference in roughness scaling behavior compared to that of fresh C5. The wear damage is visually apparent in the AFM results themselves, and the FFT results confirm change in the surface features.

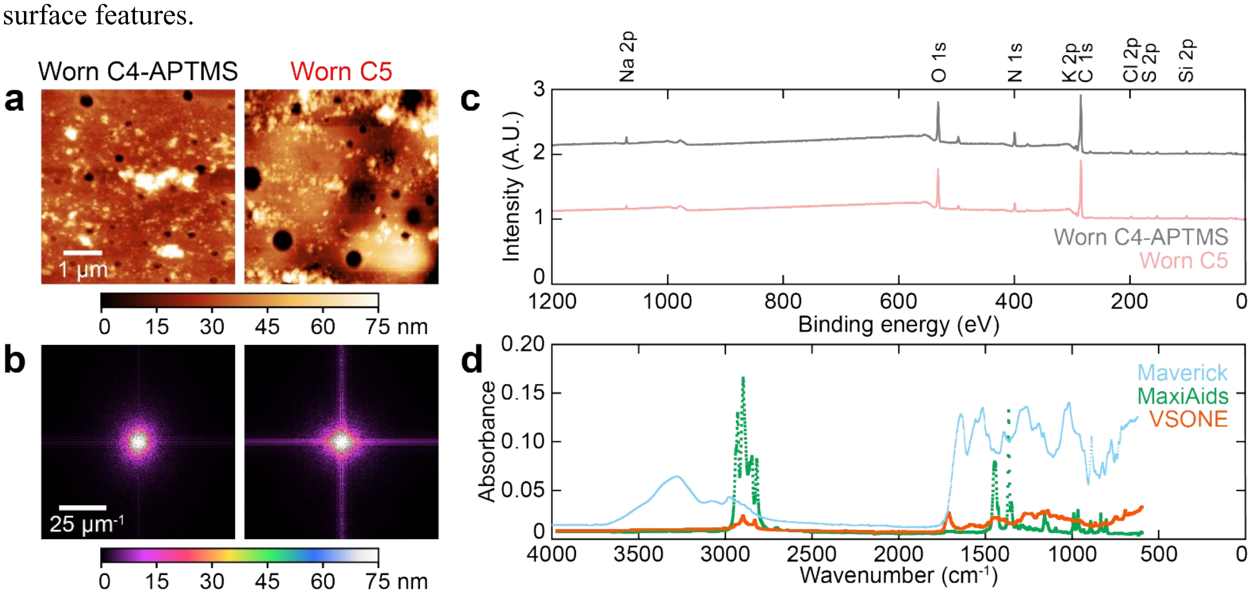

Figure S2. Materials characterization of worn sample surfaces and other brands of cards. (a) Height profiles obtained by AFM of samples worn by a human finger. (b) FFT representation of AFM surface topography to visualize ordering of the human-worn samples. (c) Relative intensity of XPS signal from samples worn by a human finger (see **Table S1**), with samples normalized to have equal oxygen peak intensities. (d) Data obtained by FTIR of uncoated examples of all brands of cards purchased.

Table S1: XPS atomic percentages of worn samples

Sample	C 1s (%)	O 1s (%)	N 1s (%)	Si 2p (%)	Ca 2p (%)	S 2p (%)	Cl 2p (%)	Na 1s (%)	K 2p (%)
Worn C4-APTMS	65.0	19.0	9.1	2.3	–	0.9	1.4	1.2	1.0
Worn C5	68.5	18.6	6.7	3.3	–	0.9	1.1	0.9	0.1

X-ray photoelectric spectroscopy (XPS). Samples worn by a human finger also showed XPS signals (**Fig. S2c**) which indicated fouling of the surface. In both of the human-worn C4-APTMS and C5 samples, we see signal increase at the Na 1s binding energy of 1071 eV and at 294 eV for K 2p. Both sodium and potassium are attributed to fouling from the human finger itself during wear, as they are known contents of perspiration present on the surface of human skin. The difference in nitrogen signal between the two human-worn samples also significantly deviated from the fresh samples. Nitrogen content lost in the worn C4-APTMS sample compared to its fresh composition is attributed to hydrolysis of the amine group.

Fourier transform infrared spectroscopy (FTIR). FTIR analysis was also performed on all brands of cards purchased (**Fig. S2d**). However, not all signal peaks could be accurately attributed in the cards' unknown composition. The most apparent explanation for why the Maverick cards performed better than those from

MaxiAids and VSONE is the broad O-H peak present in the uncoated Maverick card's signal which was not seen in signals of the other brands.

S3. Control study of uncoated black and red cards

Human participants testing. Human psychophysical testing was also conducted to establish whether participants could receive distinct tactile cues between uncoated black- and red-suited Maverick cards, which were used as substrates for all studies in this work. This testing was done as a control study to establish whether a potential difference in surfaces could be felt just from the application of black versus red pigmentation in the two groups of cards. The study was performed with blindfolded sighted participants, and the same study protocol was followed as in prior studies, only with uncoated cards. The results (**Fig. S3**) gave a mean accuracy of 40%, with performance not significantly better than chance (one-sample t-test, t(4) = -1.20, p = 0.149).

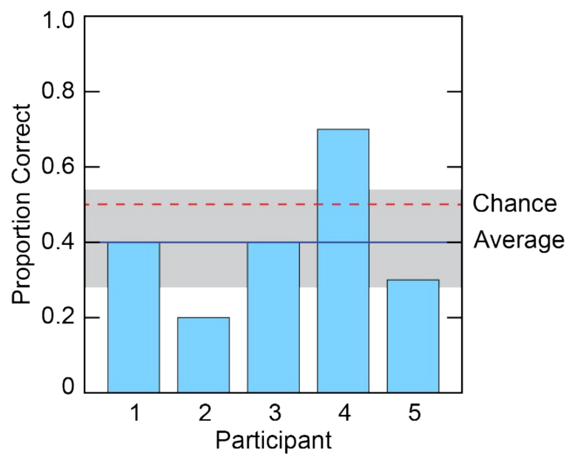

Figure S3. Control study participant performance. Average accuracy of the 2-AFC test per participant. Mean accuracy of all participants (n=50 trials) was 40% (solid dark blue line). This did not exclude chance performance, since 95% confidence (shaded in gray, calculated by Wilson score interval) ranged from 28-54%, while chance performance was 50% (dashed red line).

3D-printable tactile graphics of each figure presented in this work are available for download at: https://www.github.com/DhongLab/Alternative-Surface-Textures