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Supporting Information

Surfactants and alcohols induced disaggregation of perylene probes and a novel sensing strategy for distinguishing the brand and authenticity of makeup remover

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Synthesis of the perylene probes

Probe 1 and Probe 3 were synthesized according to our previous work [S1-S2]. Probe2 and Probe 4 were designed and synthesized according to the following route (Fig.S1, Supporting Information).

Synthesis of compound 1: Perylene-3,4,9,10-tetracarboxylic acid dianhydride (3 g, 7.6 mmol) was stirred in KOH solution (5%, 35 mL) for 4 h at 90 °C. After cooling to room temperature, 12.5 mL H₃PO₄ (10%) was added and stirred for 1 h at 90 °C. The precipitate formed was filtered, washed with water and dried in vacuum at 100 °C.

2: 2.2 **Synthesis** of compound Compound 1 (1 g, mmol). N,N-dimethylpropane-1,3-diamine (11 mmol), and water (50 mL) were stirred at 0-5 °C for 4 h. After stirring the mixture at 90 °C for 2 h, potassium carbonate (25%, 12.5 mL) was added and stirred for another 1 h at 90 °C. The precipitate was collected by vacuum filtration and washed with potassium carbonate (2%). The precipitate was dissolved in KOH (3.5%, 100 mL), heated to 90 °C, kept at this temperature for 5 min and filtered while hot. After acidification with hydrochloric acid (10%), the precipitate was collected by vacuum filtration and dried in vacuum at 100 °C.

Synthesis of compound 3: Compound 2 (1.55 g, 3.25 mmol) was added to 3-methylpyridine (50 mL) with stirring under nitrogen. Copper powder (2.0 g, 31.5 mmol) was added and the mixture heated at 160 °C for 48 h under a nitrogen

atmosphere. The reaction mixture was cooled, poured into aqueous saturated ammonium chloride solution (50 mL). The mixture was extracted with chloroform for two times (100 mL). The combined organic fractions were washed with aqueous saturated ammonium chloride solution then water and subsequently dried (anhyd. Na2SO4). The solution was filtered and the solvent was evaporated giving an orange green solid, which was subjected to column chromatography (SiO₂/CH₂Cl₂). The product was collected as the first intense orange band. Evaporation of the solvent gave a red solid, which was dried in vacuum and used without further purification.

Synthesis of Probe 2: 1.0 g of the obtained compound 3 and 4.5 mL of methyl iodide were added to 150 mL of toluene, refluxed for 3 h under N₂ atmosphere. After the mixture was cooled to room temperature, the precipitate was filtered and washed with ether and dried under vacuum to give the final product (Probe 2). ¹H NMR (400 MHz, TFA) δ 8.50 (d, J = 44.5 Hz, 3H), 8.30 (d, J = 17.0 Hz, 3H), 7.76 (s, 2H), 7.46 (s, 2H), 4.34 (s, 2H), 3.49 (s, 2H), 3.02 (s, 9H), 2.30 (s, 2H).

Synthesis of compound 4: Compound 1 (1 g, 2.2 mmol), 3-amino-1-propanol (11 mmol) and water (50 mL) were stirred at 0-5 °C for 4 h. After stirring the mixture at 90 °C for 2 h, potassium carbonate (25%, 12.5 mL) was added and stirred for another 1 h at 90 °C. The precipitate was collected by vacuum filtration and washed with potassium carbonate (2%). The precipitate was dissolved in KOH (3.5%, 100 mL), heated to 90 °C, kept at this temperature for 5 min and filtered while hot. After

acidification with hydrochloric acid (10%), the precipitate was collected by vacuum filtration and dried in vacuum at 100 °C.

Synthesis of Probe 4: Into a 50 ml Schlenk flask were charged aminocaproic acid (21 mmol), compound 4 (4.51 g, 10 mmol), and imidazole (28 g). The mixture was purged with argon for 15 minutes before being heated at 120 °C until the reaction mixture was completely soluble in water. Subsequently, the reaction mixture was cooled to 90 °C. Deionized water was then added under argon atmosphere. The dark red solution was filtered to remove the trace amount of unreacted compound 4. The solution was then acidified with 2 M HCl aqueous solution to a pH value of 3-4, the precipitate was collected by suction-filtration and thoroughly washed with deionized water until the filtrate was neutral; the red solid was collected and dried at 75 °C in vacuum oven until constant weight. ¹H NMR (500 MHz, TFA-d1) δ 8.27 (s, 8H), 7.07 (s, 1H), 4.18 (d, J = 59.7 Hz, 2H), 3.93 (s, 2H), 2.17 (s, 2H), 1.91 (d, J = 80.2 Hz, 2H), 1.48 (s, 6H), 1.22 (s, 2H).

References:

[S1] J. Li, H. Zhou, Y. Zhang, S.A. Shahzad, M. Yang, Z. Hu, et al., Tuning of the perylene probe excimer emission with silver nanoparticles, Anal. Chim. Acta 1016 (2018) 40-48.

[S2] Y. Wang, J. Chen, Y. Chen, W. Li, C. Yu, Polymer-Induced Perylene Probe Excimer Formation and Selective Sensing of DNA Methyltransferase Activity through the Monomer–Excimer Transition, Anal. Chem. 86 (2014) 4371-4378.

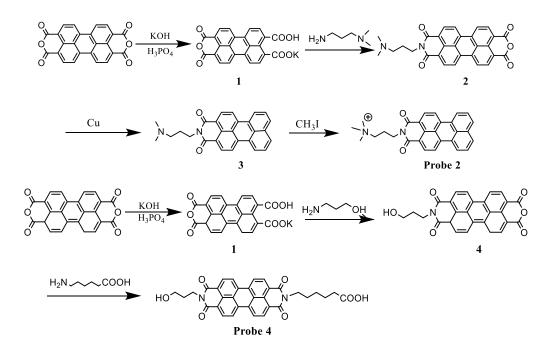


Fig. S1. The synthetic routes for Probe 2 and Probe 4.

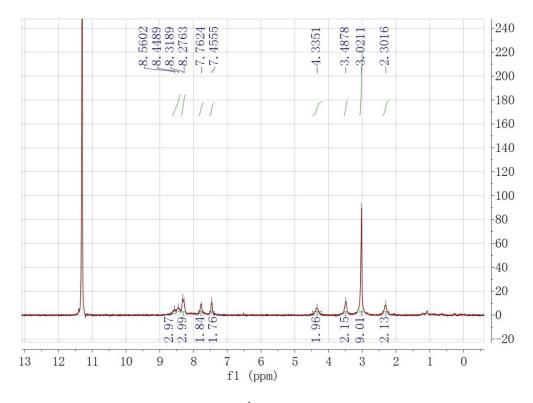


Fig. S2. ¹H NMR of Probe 2.

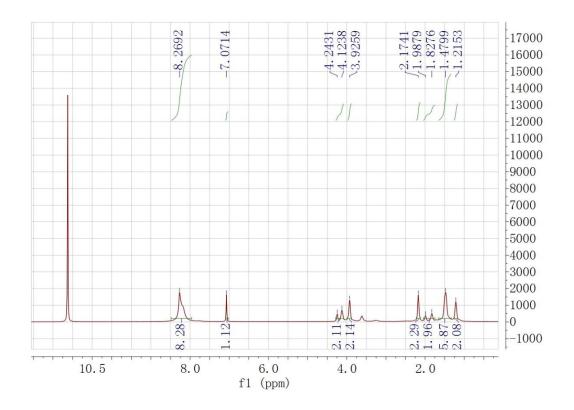


Fig. S3. ¹H NMR of Probe 4.

| | 20 r | 20 mM | | nM |
|------|-----------|--------------|-----------|----------|
| | Factor 1 | Factor 2 | Factor 1 | Factor 2 |
| | -31.48532 | 1.24763 | -31.30503 | 10.55773 |
| | -28.9016 | 3.45186 | -31.57726 | 11.33069 |
| | -32.18633 | 1.52518 | -31.93007 | 7.50043 |
| СТАВ | -30.11394 | 3.43722 | -31.96094 | 10.06688 |
| | -30.12112 | 0.58024 | -32.07319 | 7.5571 |
| | -30.95573 | 4.99127 | -31.87894 | 10.31291 |
| | 111.74399 | -3.30119 | 135.86123 | -0.06282 |
| | 113.01914 | -3.58808 | 133.85231 | -1.1341 |
| SDS | 110.42551 | -1.06808 | 138.54591 | -3.34429 |
| | 110.7114 | -2.7588 | 132.77375 | -2.78775 |
| | 114.74032 | -1.65996 | 133.28009 | -2.36906 |
| | | | | |

Table S1. LDA data for the discrimination of surfactants.

| | 113.83278 | -3.37952 | 136.17325 | -3.1518 |
|--------------|-----------|-----------|-----------|-----------|
| | -28.74102 | -27.84534 | -43.21983 | -16.45541 |
| | -28.58347 | -27.95542 | -43.22675 | -16.51893 |
| T | -28.79174 | -27.73725 | -43.19626 | -16.32766 |
| Triton X-100 | -28.89471 | -27.82518 | -43.20041 | -16.51003 |
| | -28.75465 | -27.83527 | -43.21547 | -16.53051 |
| | -29.05829 | -27.55559 | -43.22295 | -16.59119 |
| | -18.48819 | 31.62202 | -22.95483 | 15.52216 |
| | -18.40302 | 32.40364 | -22.67402 | 15.9257 |
| Tween-20 | -18.73485 | 32.28094 | -22.69277 | 15.80026 |
| I ween-20 | -18.7664 | 34.53052 | -23.44966 | 13.96437 |
| | -17.45656 | 32.74928 | -22.82508 | 15.01242 |
| | -17.21743 | 32.27319 | -22.74226 | 15.24299 |
| | -35.37282 | -4.4865 | -37.1454 | -5.85015 |
| | -34.69704 | -4.49344 | -36.9562 | -5.74801 |
| Tween-80 | -35.15572 | -4.71789 | -36.8852 | -5.74929 |
| | -34.72216 | -5.28915 | -37.4005 | -6.62413 |
| | -34.54389 | -4.9063 | -37.42914 | -6.63925 |
| | -34.32713 | -4.69001 | -37.32439 | -6.39924 |

| - | 1 n | nM | 0.5 1 | mM |
|-------------|----------|-----------|-----------|----------|
| | Factor 1 | Factor 2 | Factor 1 | Factor 2 |
| | 19.6495 | 0.96303 | 39.22931 | -2.93253 |
| | 22.24078 | 1.42895 | 41.56526 | -1.93078 |
| СТАВ | 23.3498 | 1.25648 | 39.43084 | -2.19926 |
| CIAD | 20.30619 | 0.2367 | 41.40187 | -2.85156 |
| | 23.96941 | 0.53881 | 36.95558 | -1.69622 |
| | 24.93029 | 1.25869 | 42.47401 | -2.90497 |
| | -0.73476 | -12.24197 | -15.02223 | -5.22659 |
| | -1.8583 | -12.07254 | -16.10874 | -5.76411 |
| SDS | -2.02223 | -11.6807 | -16.3955 | -6.01103 |
| 505 | -2.33362 | -11.49291 | -16.63094 | -6.67525 |
| | -2.70709 | -11.47444 | -17.00978 | -7.29708 |
| | -2.85596 | -11.72174 | -17.23188 | -7.57628 |
| | -9.41936 | -4.40925 | -15.51192 | -2.3512 |
| riton X-100 | -9.21375 | -5.65236 | -15.34898 | -2.08047 |
| 11011 A-100 | -9.31227 | -5.33401 | -15.55566 | -2.71361 |
| | -9.09583 | -6.20258 | -15.53243 | -2.13724 |
| | | | | |

| | -9.06636 | -6.36012 | -15.47769 | -2.25243 |
|-----------|----------|----------|-----------|----------|
| | -9.25366 | -5.20331 | -15.49259 | -2.11421 |
| | -2.22663 | 7.79379 | 0.66792 | 3.70456 |
| | -1.98696 | 9.22954 | 0.68907 | 4.07803 |
| Tween-20 | -2.05527 | 9.1148 | 0.30715 | 4.84659 |
| 1 ween-20 | -1.90157 | 5.58302 | 0.25165 | 7.96707 |
| | -2.25181 | 5.93911 | 0.28921 | 7.36748 |
| | -2.36543 | 6.13374 | 0.22785 | 7.16241 |
| | -9.11776 | 9.71944 | -8.90017 | 4.72965 |
| | -8.81123 | 7.64008 | -9.33753 | 4.5508 |
| Tween-80 | -8.7849 | 7.41842 | -9.06895 | 5.08055 |
| 1 ween-ou | -9.00347 | 9.44059 | -8.24822 | 6.14803 |
| | -9.04184 | 9.86966 | -8.21982 | 5.46406 |
| | -9.02592 | 10.28104 | -8.39665 | 5.6156 |

Table S2. LDA data for the discrimination of alcohols.

| | 40% | | 20 | 20% | | % |
|-------------|----------|----------|-----------|----------|-----------|----------|
| | Factor 1 | Factor 2 | Factor 1 | Factor 2 | Factor 1 | Factor 2 |
| | -41.932 | -4.855 | -28.12893 | 2.57458 | -15.30084 | -4.08551 |
| | -42.072 | -4.577 | -27.99251 | 2.52225 | -14.14666 | -4.37926 |
| Chronin | -42.164 | -4.392 | -27.44946 | 2.11053 | -15.45775 | -4.64506 |
| Glycerin | -42.048 | -4.742 | -27.35857 | 1.88532 | -15.81786 | -3.86923 |
| | -41.785 | -4.52 | -28.2619 | 2.35371 | -15.29815 | -4.04676 |
| | -42.224 | -4.485 | -27.77514 | 1.72896 | -14.28234 | -3.55918 |
| | -31.78 | 0.999 | -17.67421 | -1.02504 | -8.14719 | -1.04566 |
| | -32.614 | 2.021 | -16.97568 | -0.80234 | -8.56904 | -1.25377 |
| Ethylene | -33.056 | 2.408 | -17.94975 | -1.65704 | -8.33587 | 0.06416 |
| glycol | -32.99 | 2.514 | -16.35043 | -1.88073 | -9.85252 | -0.07238 |
| | -33.415 | 2.043 | -17.50507 | -1.31603 | -8.91472 | -1.35384 |
| | -33.085 | 2.001 | -17.43965 | -1.86759 | -9.38565 | 0.79765 |
| Isopropanol | 46.725 | -5.935 | 23.29597 | 0.44624 | 7.01274 | -4.38721 |

| | 45.793 | -6.684 | 26.00403 | -0.11515 | 10.4157 | -4.92636 |
|--------------|---------|--------|-----------|----------|-----------|----------|
| | 43.799 | -9.304 | 25.03517 | -4.13102 | 6.82086 | -5.04171 |
| | 45.121 | -8.763 | 24.57012 | -1.48885 | 9.41816 | -4.71467 |
| | 45.055 | -6.349 | 24.47795 | -2.07805 | 5.31838 | -3.18409 |
| | 44.719 | -7.705 | 23.06997 | 1.2205 | 10.13718 | -1.52373 |
| | -22.653 | 3.179 | -22.97898 | 6.17584 | -15.99899 | 5.29776 |
| | -24.91 | 4.228 | -21.26181 | 6.65625 | -15.08253 | 7.11728 |
| Methanol | -26.73 | 3.353 | -22.84753 | 5.63583 | -16.7751 | 5.31758 |
| Methanoi | -23.775 | 1.888 | -22.84181 | 7.03489 | -16.07394 | 6.06813 |
| | -23.877 | 1.681 | -22.85078 | 4.92817 | -16.5055 | 4.11414 |
| | -24.042 | 1.046 | -22.85346 | 6.41724 | -15.13219 | 5.10182 |
| | 8.287 | 7.025 | -0.49977 | -4.30826 | 4.24166 | -1.07993 |
| | 6.566 | 6.811 | -1.46003 | -6.08594 | 3.28004 | 0.21642 |
| | 5.168 | 4.224 | -0.59616 | -4.97586 | 4.17508 | -1.54376 |
| Ethanol | 8.023 | 4.97 | -3.25808 | -5.28597 | 3.31569 | -1.04035 |
| | 7.959 | 4.49 | -0.03754 | -5.70242 | 3.81457 | -2.69275 |
| | 8.765 | 4.733 | -2.55862 | -6.37019 | 3.13143 | -1.23867 |
| | -9.667 | -3.047 | 2.19617 | -4.73299 | 14.26201 | 0.34942 |
| | -12.479 | -1.03 | 3.66223 | -4.87255 | 13.68229 | 0.01993 |
| Propylene | -13.198 | -1.714 | 3.70081 | -5.78908 | 14.41821 | -0.06467 |
| glycol | -12.788 | -1.588 | 4.73234 | -5.93772 | 13.28279 | 1.01609 |
| | -12.484 | -0.689 | 3.91293 | -6.1324 | 14.691 | -0.72153 |
| | -11.761 | -1.077 | 4.88008 | -6.60151 | 15.18296 | 0.20845 |
| | 59.007 | 3.859 | 40.33157 | 5.66437 | 14.70763 | 2.84792 |
| Tert-butanol | 59.189 | 5.199 | 43.33217 | 5.81353 | 14.43891 | 6.36069 |
| | 58.577 | 1.874 | 42.072 | 6.26588 | 12.86584 | 3.43049 |
| | 59.01 | 3.955 | 39.73619 | 4.60525 | 13.85892 | 3.54099 |
| | 58.137 | 3.664 | 39.24362 | 3.32002 | 13.68336 | 3.18325 |
| | 57.629 | 3.292 | 40.65254 | 5.79736 | 12.92145 | 5.41792 |
| | | | | | | |

| -14.30902 42.39193 -8.17729 -8.70368 -14.9273 40.90953 -7.96452 -8.9346 -14.31264 41.32041 -7.69833 -8.25683 -14.66724 40.72283 -8.1499 -8.98039 -14.16157 40.53745 -8.17367 -9.17418 5.38446 18.5846 -19.0293 -18.38052 5.98473 18.44377 -19.01997 -18.39529 4.60351 18.411 -19.0293 -18.38052 4.60351 18.411 -19.0423 -18.34669 4.33243 17.56129 -19.37718 -18.27613 136.79879 -35.16523 -11.44367 -10.40085 136.00099 -35.10596 -11.44367 -10.40085 130.51837 -34.22401 14 -11.56125 -10.2336 129.29262 -32.38505 -12.03548 -11.38446 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.28796 -16.04119 -0.96842 | | Factor 1 | Factor 2 | | Factor 1 | Factor 2 |
|---|---|-----------|-----------|----|-----------|-----------|
| 1 -14.31264 41.32041 40.72283 12 -7.69833 -8.1499 -8.25683 -8.1499 -14.16157 40.53745 -8.1499 -8.98039 -14.16157 40.53745 -8.27082 -8.48684 -15.2074 39.71205 -8.17367 -9.17418 5.38446 18.5846 -19.0293 -18.38052 5.98473 18.44377 -19.41856 -18.32668 4.31702 16.39685 -19.09423 -18.34069 4.30968 16.8516 -19.09423 -18.34069 -19.18216 -18.40341 -19.37718 -18.27613 136.79879 -35.16523 -11.44367 -10.40085 130.51837 -34.22401 14 -11.56125 -10.2336 133.02318 -32.3344 -11.59907 -10.39638 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.28796 -16.04119 -19.52587 -15.89483 -21.0053 -15.94204 -20.66699 -15.6862 -21.0053 | | -14.30902 | 42.39193 | | -8.17729 | -8.70368 |
| 1 -14.66724 40.72283 12 -8.1499 -8.98039 -14.16157 40.53745 -8.27082 -8.48684 -15.2074 39.71205 -8.17367 -9.17418 5.38446 18.5846 -19.0293 -18.38052 5.98473 18.44377 -19.41856 -18.32668 4.31702 16.39685 13 -19.0997 -18.39529 4.60351 18.411 -19.09423 -18.34069 4.33243 17.56129 -19.16997 -18.39529 -19.37718 -18.27613 -19.37718 -18.27613 136.79879 -35.16523 -11.44367 -10.40085 133.02318 -32.3344 14 -11.56125 -10.2336 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.28796 -16.04119 -0.96846 26.15559 15 -20.28796 -16.04119 -0.9797 26.66636 -21.0053 | | -14.9273 | 40.90953 | | -7.96452 | -8.9346 |
| -14.66724 40.72283 -8.1499 -8.98039 -14.16157 40.53745 -8.27082 -8.48684 -15.2074 39.71205 -8.17367 -9.17418 5.38446 18.5846 -9.17418 -19.0293 -18.38052 2 4.31702 16.39685 -19.16997 -18.32668 4.30968 16.8516 -19.18216 -18.40341 4.33243 17.56129 -19.37718 -18.27613 3 136.79879 -35.16523 -11.44367 -10.40085 136.00099 -35.10596 -11.941856 -11.38446 -129.4244 -33.50917 -11.44367 -10.40085 133.02318 -32.3344 -11.56125 -10.2336 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.87092 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.28796 -16.04119 -0.96846 26.15559 -19.52587 -15.89483 | 1 | -14.31264 | 41.32041 | 10 | -7.69833 | -8.25683 |
| -15.2074 39.71205 -8.17367 -9.17418 5.38446 18.5846 -19.0293 -18.38052 2 4.31702 16.39685 -19.1941856 -18.32668 4.30968 16.8516 -19.09423 -18.34069 4.30968 16.8516 -19.1997 -18.39529 3 136.79879 -35.16523 -19.1997 -18.34069 130.51837 -34.22401 -19.37718 -18.27613 3 130.51837 -34.22401 -11.44367 -10.40085 133.02318 -32.3344 -11.56125 -10.2336 -11.94944 -11.694 -11.694 -11.694 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.28796 -16.04119 -0.93797 26.66636 -20.28796 -16.04119 -0.93797 26.66636 -21.0053 -15.4862 </td <th>I</th> <td>-14.66724</td> <td>40.72283</td> <th>12</th> <td>-8.1499</td> <td>-8.98039</td> | I | -14.66724 | 40.72283 | 12 | -8.1499 | -8.98039 |
| 5.38446 18.5846 -19.0293 -18.38052 2 4.31702 16.39685 -19.41856 -18.32668 4.30968 16.8516 -19.09423 -18.34069 4.30968 16.8516 -19.18216 -18.40341 4.33243 17.56129 -19.37718 -18.27613 3 136.79879 -35.16523 -11.44367 -10.40085 130.51837 -34.22401 14 -11.56125 -10.2336 133.02318 -32.3344 -11.94944 -11.694 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.24242 -15.87092 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.028796 -16.04119 -0.93797 26.66636 -20.06699 -15.6862 -21.09823 11.40702 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90046 | | -14.16157 | 40.53745 | | -8.27082 | -8.48684 |
| 2 5.98473 18.44377 16.39685 4.31702 16.39685 4.60351 18.411 4.30968 16.8516 4.33243 17.56129 -19.18216 -18.40341 -19.37718 -18.27613 136.79879 -35.16523 136.0099 -35.10596 133.02318 -32.3344 129.4244 -33.50917 129.29262 -32.38505 -11.44367 -10.40085 -11.59907 -10.39638 -11.59907 -10.39638 -11.94944 -11.694 -11.59907 -10.39638 -11.94944 -11.694 -11.59907 -10.39638 -12.17743 -12.41465 -0.42856 25.19206 -0.96846 26.15559 -0.41229 27.98859 -1.69618 23.82801 -0.93797 26.66636 -20.028796 -16.04119 -19.52587 -15.89483 -21.0053 -15.94204 -0.93797 26.66636 -21.98823 11.40702 -21.00586 -17.00342 -21.4989 11.24325 -21.4989 11.24325 -21.60231 12.21848 -16 -21.60231 12.21848 -21.60231 12.21848 -21.6081 11.1724 -21.0586 -17.00342 -20.79829 -16.90373 -21.00584 -16.90373 -20.79829 -16.92873 -21.05681 -16.90496 -20.80707 -16.90496 -20.80707 -16.90496 -20.34277 -15.96632 | | -15.2074 | 39.71205 | | -8.17367 | -9.17418 |
| 2 4.31702 16.39685 13 -19.16997 -18.39529 4.60351 18.411 -19.09423 -18.34069 4.30968 16.8516 -19.18216 -18.40341 4.33243 17.56129 -19.37718 -18.27613 3 136.79879 -35.16523 -11.44367 -10.40085 130.51837 -34.22401 14 -11.56125 -10.2336 133.02318 -32.3344 -11.59907 -10.39638 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.52587 -15.87092 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.28796 -16.04119 -0.93797 26.66636 -21.0053 -15.89483 -11.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -21.00586 -17.00342 -21.60231 12.21848 -21.35004 -16.90373 -21.66981 11.1724 -20.366043 - | | 5.38446 | 18.5846 | | -19.0293 | -18.38052 |
| 2 4.60351 18.411 13 -19.09423 -18.34069 4.30968 16.8516 -19.18216 -18.40341 4.33243 17.56129 -19.37718 -18.27613 3 136.79879 -35.16523 -11.44367 -10.40085 130.51837 -34.22401 14 -11.56125 -10.2336 130.51837 -34.22401 14 -11.56125 -10.2336 129.29262 -32.38505 -11.59907 -10.39638 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.28796 -16.04119 -0.93797 26.66636 -21.0053 -15.87092 -0.93797 26.66636 -21.0053 -15.94204 -0.93797 26.66636 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90046 -21.72077 12.05589 -21.063 | | 5.98473 | 18.44377 | | -19.41856 | -18.32668 |
| 4.60351 18.411 -19.09423 -18.34069 4.30968 16.8516 -19.18216 -18.40341 4.33243 17.56129 -19.37718 -18.27613 3 136.79879 -35.16523 -11.44367 -10.40085 136.00099 -35.10596 -11.56125 -10.2336 130.51837 -34.22401 14 -11.56125 -10.2336 133.02318 -32.3344 -11.94944 -11.694 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.24242 -15.87092 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -20.28796 -16.04119 -0.42856 25.19206 -21.0053 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90473 -21.60231 12.21848 -21.35004 -16.90373 | 2 | 4.31702 | 16.39685 | 12 | -19.16997 | -18.39529 |
| 4.33243 17.56129 -19.37718 -18.27613 3 136.79879 -35.16523 -11.44367 -10.40085 3 130.51837 -34.22401 14 -11.56125 -10.2336 130.51837 -34.22401 14 -11.56125 -10.2336 -11.94944 -11.694 129.4244 -33.50917 -11.59007 -10.39638 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -0.42856 25.19206 -20.28796 -16.04119 -19.52587 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -20.66699 -15.6862 -21.98823 11.40702 -21.0053 -15.94204 -20.66699 -15.6862 -21.60231 12.21848 -21.60231 -21.217053 -16.90046 -21.35004 -16.900373 -21.60231 12.21848 -21.35004 -16.90373 -21.06381 -16.94315 -21.72077 12.05589 -21.06381 -16.94315 -20. | 2 | 4.60351 | 18.411 | 15 | -19.09423 | -18.34069 |
| 3 136.79879 -35.16523 -11.44367 -10.40085 3 136.00099 -35.10596 -12.03548 -11.38446 130.51837 -34.22401 14 -11.56125 -10.2336 129.4244 -33.50917 -11.94944 -11.694 129.29262 -32.38505 -11.94944 -11.694 -0.42856 25.19206 -11.44367 -10.2336 -0.42856 25.19206 -11.59907 -10.39638 -0.42856 25.19206 -11.59907 -15.97274 -0.42856 25.19206 -20.28796 -16.04119 -0.41229 27.98859 -15 -20.28796 -16.04119 -0.96846 26.15559 -21.0053 -15.94204 -0.93797 26.66636 -21.0053 -15.94204 -0.93797 26.66636 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90046 -21.72077 12.05589 -20.80707 -16.90373 -21.66981 11.1724 -20.80707 | | 4.30968 | 16.8516 | | -19.18216 | -18.40341 |
| 3 136.00099 -35.10596 14 -12.03548 -11.38446 3 130.51837 -34.22401 14 -11.56125 -10.2336 129.4244 -33.50917 -11.59907 -10.39638 -11.39434 129.29262 -32.38505 -11.59907 -10.39638 129.29262 -32.38505 -11.59907 -10.39638 -0.42856 25.19206 -0.96846 26.15559 -0.41229 27.98859 -15 -20.28796 -16.04119 -0.41229 27.98859 -15.98483 -21.0053 -15.94204 -0.93797 26.66636 -21.0053 -15.94204 -20.86699 -15.6862 -21.4989 11.24325 -21.00536 -17.00342 -20.86043 -16.900373 -20.86043 -16.900373 -20.79829 -16.92873 -21.69281 11.1724 -20.86043 -16.90373 -21.69281 -21.72077 12.05589 -21.06381 -16.94315 -20.79829 -16.92873 -21.06381 -16.94315 -20.80707 -16.90496 -20.80707 | | 4.33243 | 17.56129 | | -19.37718 | -18.27613 |
| 3 130.51837 -34.22401 14 -11.56125 -10.2336 133.02318 -32.3344 -11.94944 -11.694 129.4244 -33.50917 -11.59907 -10.39638 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.24242 -15.87092 -0.42856 25.19206 -20.28796 -16.04119 -0.41229 27.98859 -19.52587 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90046 -21.60231 12.21848 -21.00586 -17.00342 -21.66981 11.1724 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 29.2044 67.36547 17 -19.72317 -16.44333 | | 136.79879 | -35.16523 | | -11.44367 | -10.40085 |
| 3 133.02318 -32.3344 -14 -11.94944 -11.694 129.4244 -33.50917 -11.59907 -10.39638 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.24242 -15.87092 -0.41229 27.98859 -16.04119 -19.52587 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -20.66699 -15.6862 -21.4989 11.24325 -20.86043 -16.90046 -21.60231 12.21848 -21.35004 -16.90373 -21.66981 11.1724 -20.86043 -16.90373 -21.66981 11.1724 -20.79829 -16.92873 -21.60231 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.34277 -15.96632 -27.31523 59.79203 -19.72317 -16.44333 -29.2044 67.36547 17 -20.11816 -15.89461 <th></th> <td>136.00099</td> <td>-35.10596</td> <th></th> <td>-12.03548</td> <td>-11.38446</td> | | 136.00099 | -35.10596 | | -12.03548 | -11.38446 |
| 133.02318 -32.3344 -11.94944 -11.694 129.4244 -33.50917 -11.59907 -10.39638 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.24242 -15.87092 -0.42856 26.15559 -0.96846 26.15559 -0.41229 27.98859 -19.52587 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -20.66699 -15.6862 -21.4989 11.24325 -20.86043 -16.90046 -21.60231 12.21848 -21.00586 -17.00342 -21.66981 11.1724 -20.79829 -16.92873 -21.66981 11.1724 -20.86043 -16.90373 -21.83324 10.76439 -20.80707 -16.92873 -21.06381 -16.94315 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 29.2044 67.36547 17 -20.11816 -15.89461 | 3 | 130.51837 | -34.22401 | 14 | -11.56125 | -10.2336 |
| 129.29262 -32.38505 -12.17743 -12.41465 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.24242 -15.87092 -0.96846 26.15559 -0.41229 27.98859 -16.69618 23.82801 -20.28796 -16.04119 -0.93797 26.66636 -21.0053 -15.94204 -0.93797 26.66636 -20.86043 -16.90046 -21.4989 11.24325 -20.86043 -16.90046 -21.60231 12.21848 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.90373 -21.83324 10.76439 -20.80707 -16.90496 -21.83324 10.76439 -20.34277 -15.96632 -27.31523 59.79203 -19.72317 -16.44333 -20.11816 -15.89461 -15.89461 | 3 | 133.02318 | -32.3344 | 14 | -11.94944 | -11.694 |
| 0.22913 27.52343 -19.32127 -15.97274 -0.42856 25.19206 -20.24242 -15.87092 -0.41229 27.98859 -19.52587 -16.04119 -0.93797 26.66636 -21.0053 -15.94204 -0.93797 26.66636 -20.66699 -15.6862 -21.98823 11.40702 -20.86043 -16.90046 -21.60231 12.21848 -20.86043 -16.90373 -21.66981 11.1724 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.86043 -16.90373 -20.80707 -16.92873 -21.06381 -16.94315 -21.72077 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 -19.72317 -16.44333 -20.11816 -15.89461 | | 129.4244 | -33.50917 | | -11.59907 | -10.39638 |
| 4 -0.42856 25.19206 -20.24242 -15.87092 -0.96846 26.15559 -20.28796 -16.04119 -0.41229 27.98859 -15.89483 -1.69618 23.82801 -15.89483 -0.93797 26.66636 -21.0053 -15.94204 -0.93797 26.66636 -20.66699 -15.6862 -21.4989 11.24325 -21.00586 -17.00342 -21.60231 12.21848 -20.86043 -16.90046 -21.72077 12.05589 -21.06381 -16.90373 -21.72077 12.05589 -21.06381 -16.92873 -21.83324 10.76439 -20.80707 -16.90496 -20.80707 -16.90496 -20.80707 -16.90496 -21.83324 10.76439 -20.34277 -15.96632 -27.31523 59.79203 17 -20.34277 -15.96632 -29.2044 67.36547 17 -20.11816 -15.89461 | | 129.29262 | -32.38505 | | -12.17743 | -12.41465 |
| 4 -0.96846 26.15559 15 -20.28796 -16.04119 -0.41229 27.98859 -19.52587 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -20.66699 -15.6862 -21.98823 11.40702 -21.00586 -17.00342 -21.60231 12.21848 -21.35004 -16.90046 -21.72077 12.05589 -21.06381 -16.90373 -21.83324 10.76439 -20.80707 -16.90496 -21.83324 10.76439 -20.34277 -15.96632 27.31523 59.79203 17 -19.72317 -16.44333 29.2044 67.36547 17 -20.11816 -15.89461 | | 0.22913 | 27.52343 | | -19.32127 | -15.97274 |
| 4 -0.41229 27.98859 15 -19.52587 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -20.66699 -15.6862 -21.98823 11.40702 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90046 -21.60231 12.21848 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.90373 -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 27.31523 59.79203 17 -19.72317 -16.44333 29.2044 67.36547 17 -20.11816 -15.89461 | | -0.42856 | 25.19206 | | -20.24242 | -15.87092 |
| -0.41229 27.98859 -19.52587 -15.89483 -1.69618 23.82801 -21.0053 -15.94204 -0.93797 26.66636 -20.66699 -15.6862 -21.98823 11.40702 -20.66699 -15.6862 -21.98823 11.40702 -20.86043 -16.90046 -21.60231 12.21848 -21.35004 -16.90373 -21.66981 11.1724 -20.79829 -16.92873 -21.83324 10.76439 -20.80707 -16.90496 -21.83324 10.76439 -20.80707 -16.90496 -20.34277 -15.96632 -20.34277 -15.96632 -20.34277 -15.96632 -20.34277 -15.96632 -20.34277 -15.96632 -20.34277 -15.96632 -20.34277 -15.96632 -20.34277 -15.96632 -20.11816 -15.89461 | 4 | -0.96846 | 26.15559 | 15 | -20.28796 | -16.04119 |
| -0.93797 26.66636 -20.66699 -15.6862 -21.98823 11.40702 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90046 -21.60231 12.21848 -20.79829 -16.90373 -21.66981 11.1724 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 27.31523 59.79203 17 -19.72317 -16.44333 -20.11816 -15.89461 -15.89461 -20.11816 -15.89461 | - | -0.41229 | 27.98859 | 13 | -19.52587 | -15.89483 |
| -21.98823 11.40702 -21.00586 -17.00342 -21.4989 11.24325 -20.86043 -16.90046 -21.60231 12.21848 -21.35004 -16.90373 -21.66981 11.1724 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 27.31523 59.79203 17 -19.72317 -16.44333 -29.2044 67.36547 17 -20.11816 -15.89461 | | -1.69618 | 23.82801 | | -21.0053 | -15.94204 |
| 5 -21.4989 11.24325 -20.86043 -16.90046 5 -21.60231 12.21848 -21.35004 -16.90373 -21.66981 11.1724 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 27.31523 59.79203 -19.72317 -16.44333 29.2044 67.36547 17 -20.11816 -15.89461 | | -0.93797 | 26.66636 | | -20.66699 | -15.6862 |
| 5 -21.60231 12.21848 16 -21.35004 -16.90373 -21.66981 11.1724 -20.79829 -16.92873 -21.72077 12.05589 -21.06381 -16.94315 -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 27.31523 59.79203 -19.72317 -16.44333 29.2044 67.36547 17 -20.11816 -15.89461 | | -21.98823 | 11.40702 | | -21.00586 | -17.00342 |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | -21.4989 | 11.24325 | | -20.86043 | -16.90046 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 5 | -21.60231 | 12.21848 | 16 | -21.35004 | -16.90373 |
| -21.83324 10.76439 -20.80707 -16.90496 29.30031 66.96019 -20.34277 -15.96632 27.31523 59.79203 -19.72317 -16.44333 29.2044 67.36547 17 -20.11816 -15.89461 | 3 | -21.66981 | 11.1724 | 10 | -20.79829 | -16.92873 |
| 29.30031 66.96019 -20.34277 -15.96632 27.31523 59.79203 17 -19.72317 -16.44333 29.2044 67.36547 17 -20.11816 -15.89461 | | -21.72077 | 12.05589 | | -21.06381 | -16.94315 |
| 627.3152359.7920317-19.72317-16.4433329.204467.3654717-20.11816-15.89461 | | -21.83324 | 10.76439 | | -20.80707 | -16.90496 |
| 6 29.2044 67.36547 17 -20.11816 -15.89461 | | 29.30031 | 66.96019 | | -20.34277 | -15.96632 |
| 29.2044 67.36547 -20.11816 -15.89461 | 6 | 27.31523 | 59.79203 | 17 | -19.72317 | -16.44333 |
| 28.03668 63.19335 -20.09855 -16.4368 | U | 29.2044 | 67.36547 | 1/ | -20.11816 | -15.89461 |
| | | 28.03668 | 63.19335 | | -20.09855 | -16.4368 |

Table S3. LDA data for the discrimination of nine brands of commercial makeupremovers (1-9) and common liquid goods (10-21).

| | 27.25821 | 65.06487 | | -20.10927 | -15.84148 |
|----|-----------|-----------|----|-----------|-----------|
| | 28.77945 | 62.84179 | | -20.36973 | -16.50923 |
| | 59.24193 | 1.44869 | | -22.2323 | -17.36188 |
| | 57.95345 | 3.9291 | | -20.83171 | -17.85766 |
| - | 60.52383 | 1.31988 | 10 | -21.86509 | -17.4847 |
| 7 | 54.4684 | 2.92047 | 18 | -21.08036 | -17.85086 |
| | 60.37225 | 0.83121 | | -21.80642 | -17.6272 |
| | 59.39569 | 2.03685 | | -21.41552 | -17.72298 |
| | 9.58461 | 47.01372 | | -21.43016 | -14.56685 |
| | 9.2666 | 47.04732 | | -21.30144 | -14.55239 |
| 8 | 9.56883 | 46.79314 | 19 | -21.40184 | -14.68365 |
| o | 7.49168 | 42.74172 | 19 | -21.35438 | -14.25368 |
| | 8.55597 | 45.23342 | | -21.33524 | -14.23696 |
| | 8.28298 | 43.43859 | | -21.43468 | -14.61794 |
| | -2.28591 | -4.53816 | | -12.14648 | -8.71407 |
| | -2.89204 | -3.48177 | 20 | -12.17995 | -8.37553 |
| 9 | -2.99507 | -4.37595 | | -12.18701 | -9.08584 |
| 9 | -4.13672 | -3.45031 | 20 | -11.89329 | -8.45306 |
| | -1.66947 | -4.62642 | | -12.09081 | -7.47025 |
| | -3.57274 | -3.87243 | | -12.47582 | -8.37634 |
| | -10.87742 | -13.6552 | | -15.90399 | -18.42469 |
| | -12.01716 | -14.79519 | | -15.79786 | -18.24951 |
| 10 | -11.14561 | -14.24223 | 21 | -16.06023 | -18.31443 |
| 10 | -11.92433 | -14.84376 | 21 | -16.21588 | -17.94584 |
| | -11.11541 | -14.55104 | | -16.24605 | -18.22226 |
| | -11.67412 | -14.87524 | | -16.93417 | -17.75877 |
| | -9.74441 | -9.67023 | | | |
| | -10.00783 | -10.08103 | | | |
| 11 | -10.49521 | -9.51835 | | | |
| 11 | -9.51775 | -9.71651 | | | |
| | -10.66129 | -9.73772 | | | |
| | -9.9555 | -9.8006 | | | |
| | | | | | |

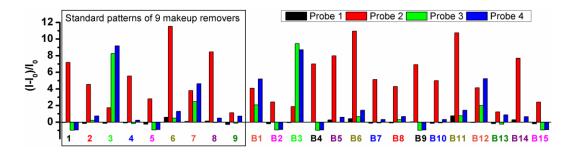


Fig. S4. Response of the four-channel sensor array against the 9 known makeup removers (1-9) and the 15 blind makeup remover samples (B1-B15). Same color represents the same brand of makeup remover.

| Sample | Identification | Verification | Y/N |
|------------|----------------|--------------|-----|
| B 1 | #7 | #7 | Y |
| B2 | #5 | #5 | Y |
| B3 | #3 | #3 | Y |
| B4 | #1 | #1 | Y |
| B5 | #8 | #8 | Y |
| B6 | #6 | #6 | Y |
| B7 | #4 | #4 | Y |
| B8 | #2 | #2 | Y |
| B9 | #1 | #1 | Y |
| B10 | #4 | #4 | Y |
| B11 | #6 | #6 | Y |
| B12 | #7 | #7 | Y |
| B13 | #9 | #9 | Y |
| B14 | #8 | #8 | Y |
| B15 | #5 | #5 | Y |

Table S4. Identification of the 15 blind makeup remover samples.

100% identified, 0% error rate