

## Supporting Information

### Degradation of Methyl Orange by dielectric films based on contact-electro-catalysis

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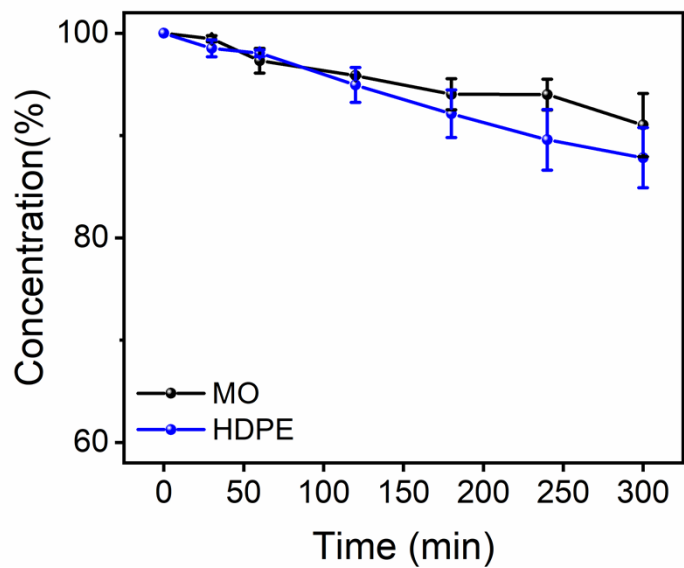
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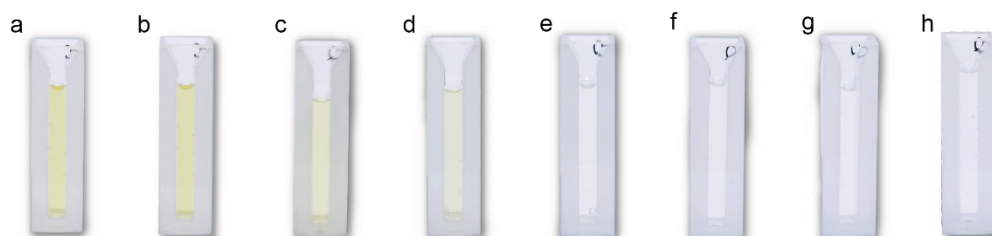
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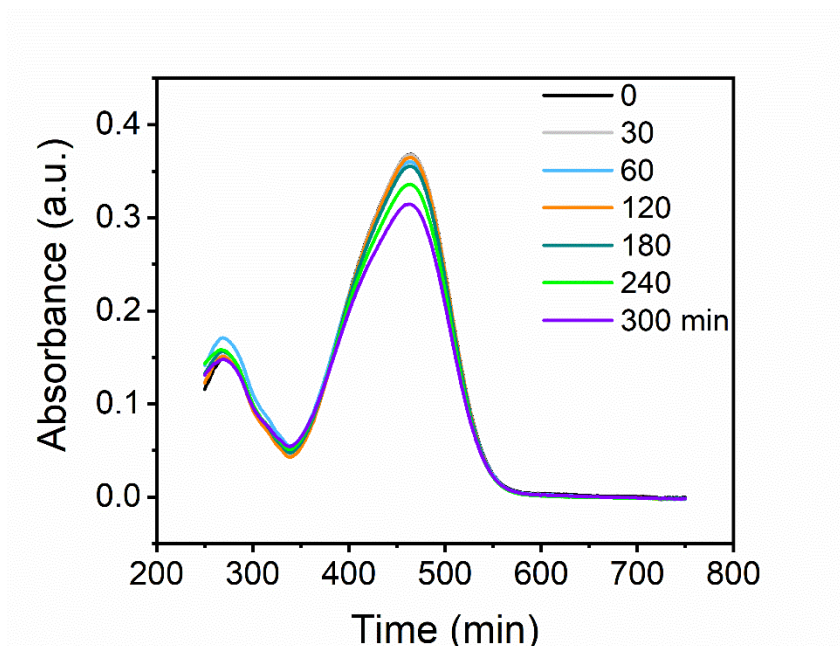
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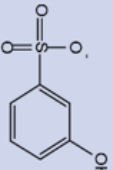
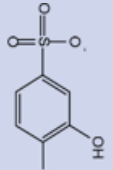
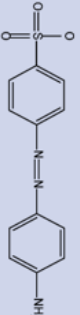
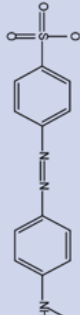
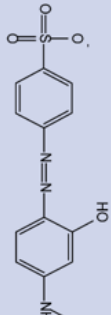
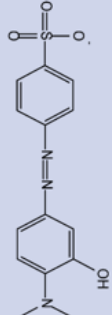
**Figure S1.** Degradation of methyl orange with/without HDPE film for 5 hours. Error bars represent standard deviation based on three replicate data.



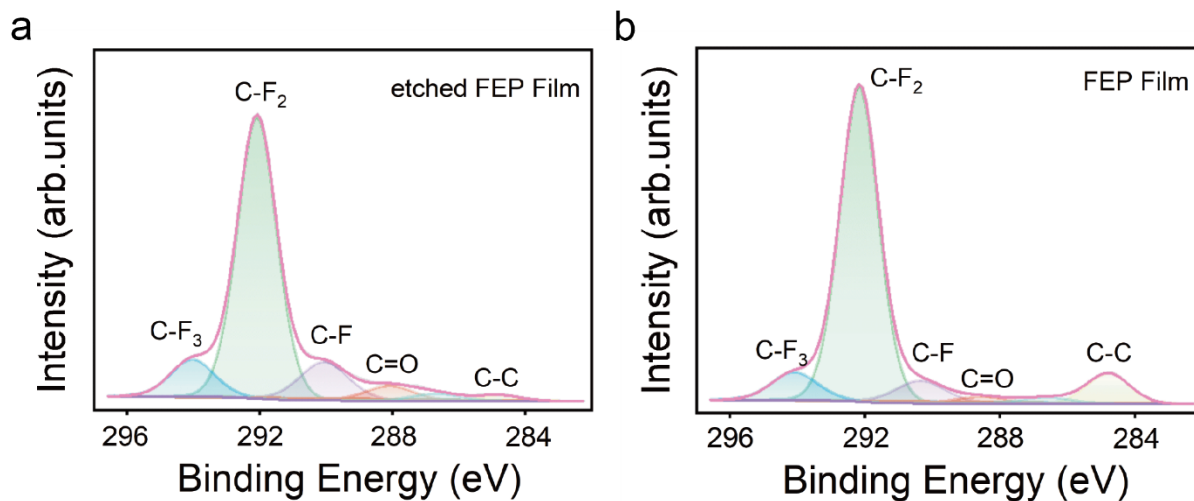
**Figure S2.** Comparison of absorbance of MO solution with/without etched FEP film in **a**, 0 min, **b**, 30 min **c**, 60 min **d**, 120 min, **e**, 180 min, **f**, 240 min, **g**, 300min, **h**, 600 min ultrasonication.



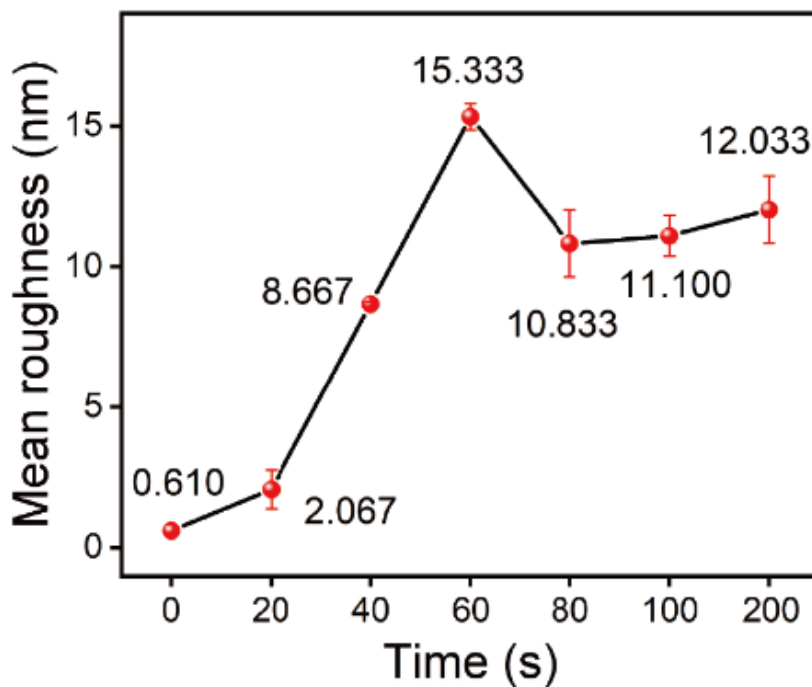
**Figure S3.** UV-Vis spectra of a 50 mL MO solution during ultrasonication with none.

m/z	173	218	276	290	306	320
<b>Degradation Products</b>						

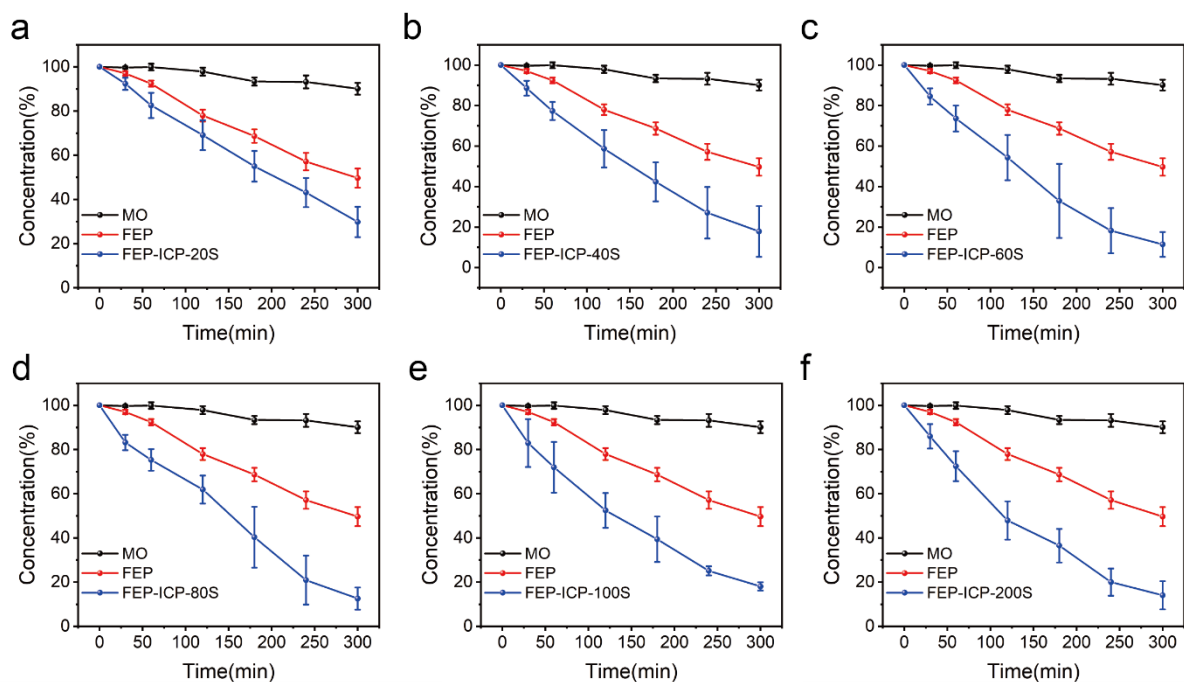
**Figure S4.** The chemical structure of the product during the CEC degradation of methyl orange as identified by mass-spectroscopy.



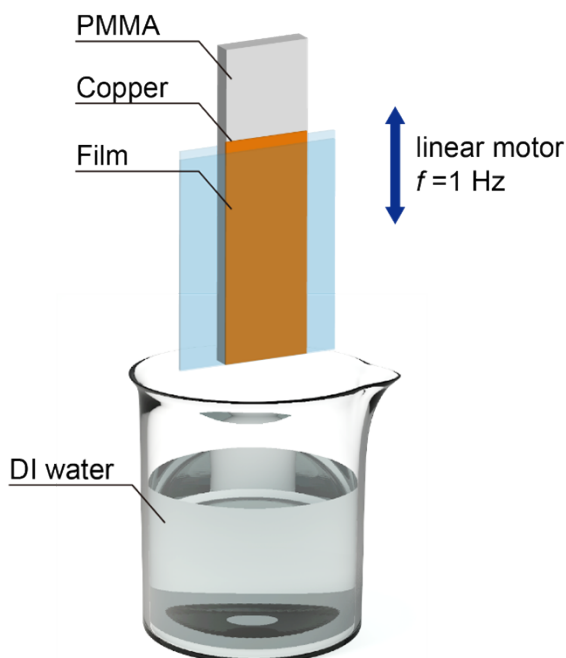
**Figure S5.** C1s, F1s and O1s XPS spectra of FEP film **a**, before and **b**, after plasma etching with Ar gas.



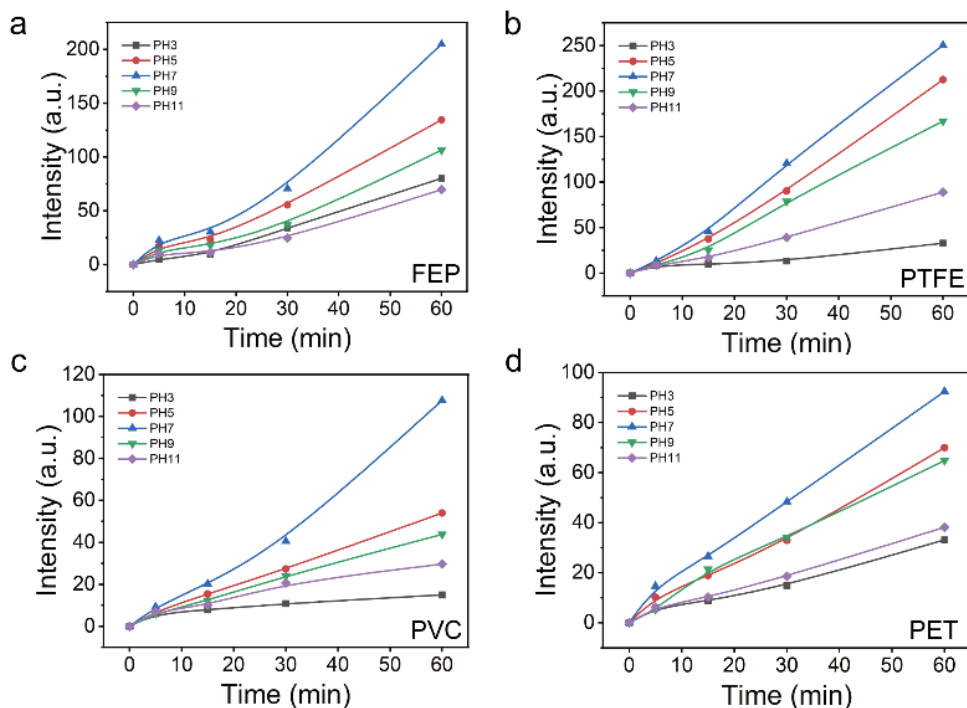
**Figure S6.** Surface roughness of FEP film at different etching time. Error bars represent standard deviation based on three replicate data.



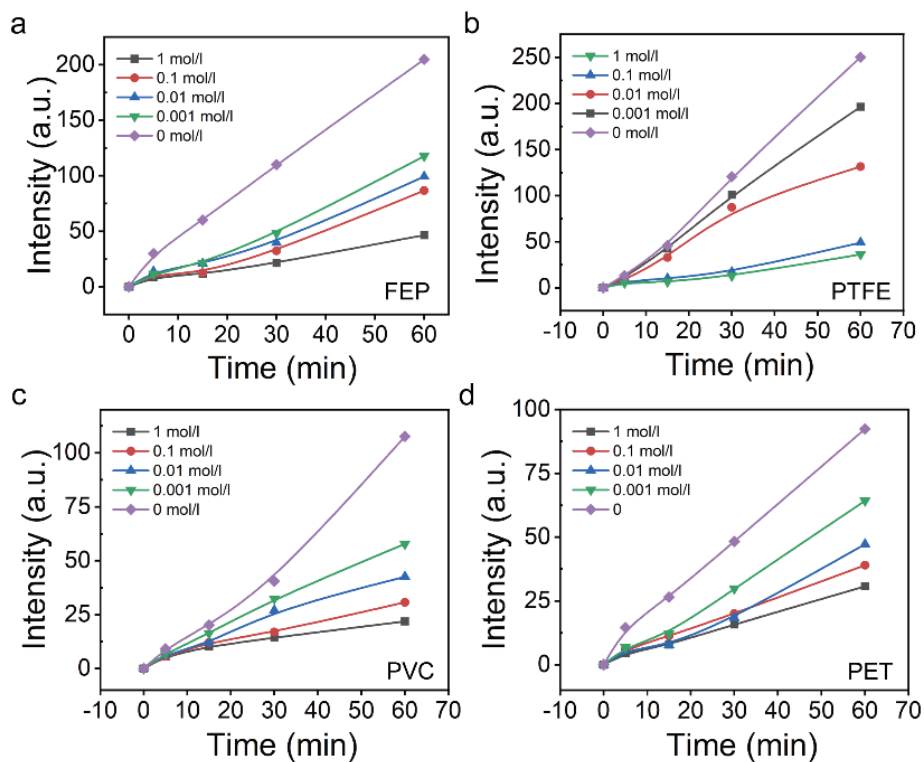
**Figure S7.** Degradation of methyl orange with **a**, 20 s **b**, 40 s **c**, 60 s **d**, 80 s **e**, 100 s **f**, 200 s etched film during ultrasonication. Error bars represent standard deviation based on three replicate data.



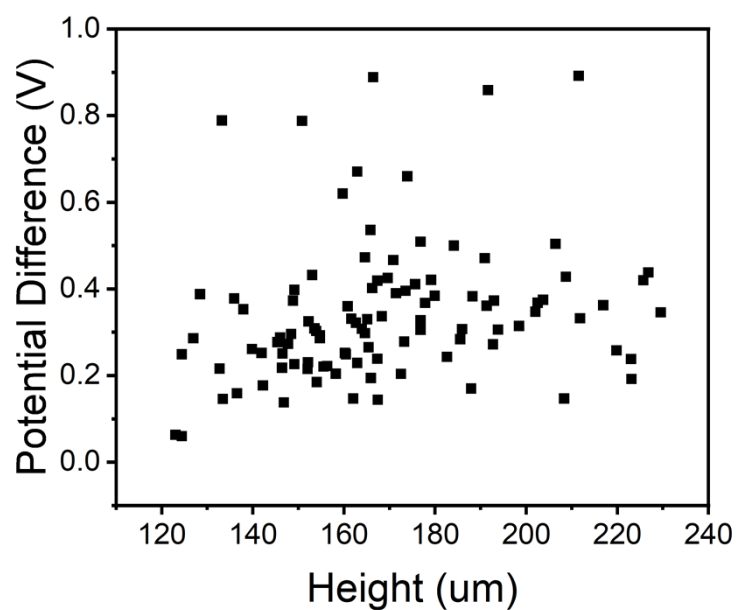
**Figure S8.** Demonstration of measuring the transferred charge of a SE-TENG which is repeatedly immersed in DI water.



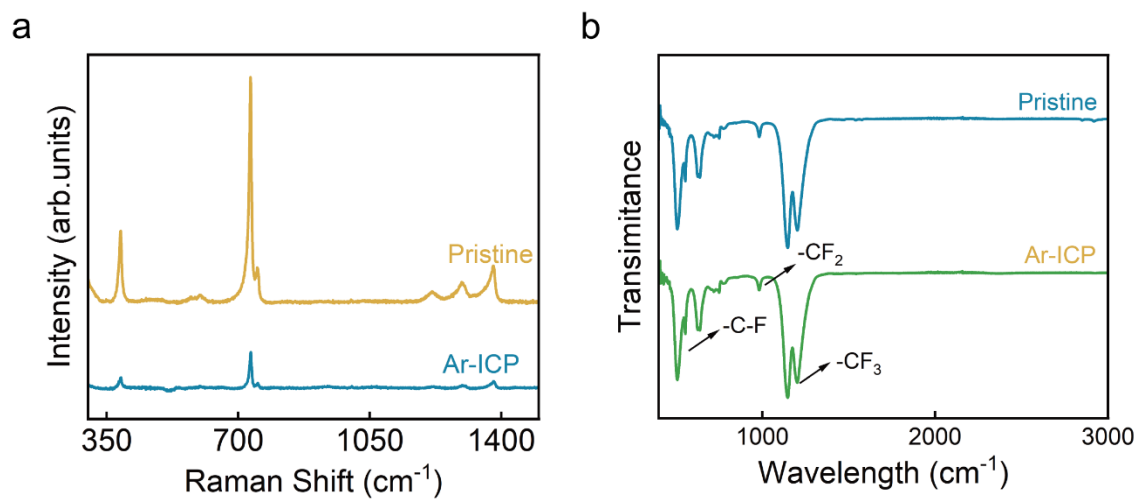
**Figure S9.** THA-OH intensity reacted in various PH with FEP (a), PTFE (b), PVC (c), and PET (d) etched films.



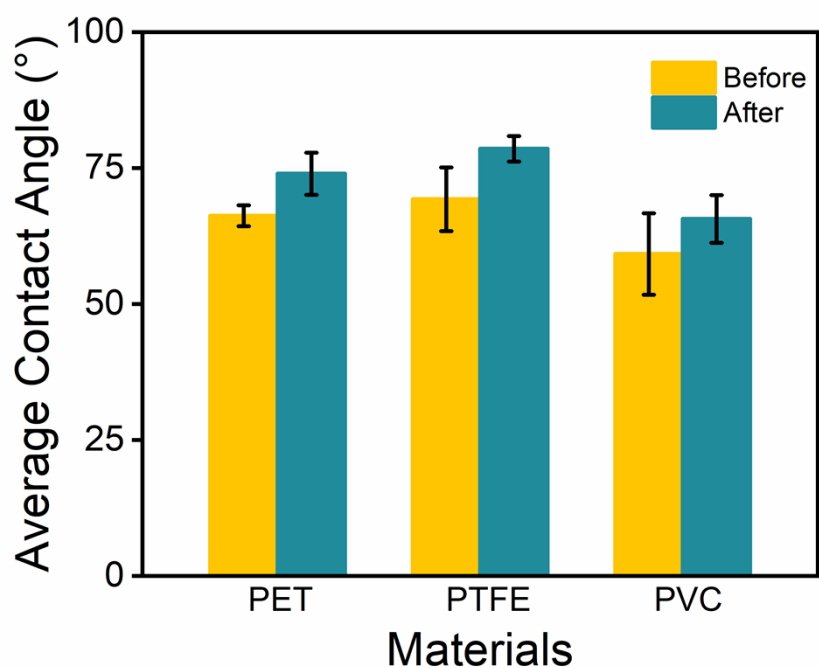
**Figure S10.** THA-OH intensity reacted in various NaCl concentration with FEP (a), PTFE (b), PVC (c), and PET (d) etched films.



**Figure S11.** One hundred measurements of potential difference depend on height between peak and bottom of structure.



**Figure S12.** Raman (a) and ATR-FTIR spectra (b) for pristine and 60 seconds Ar-ICP etched FEP films.



**Figure S13.** Contact angle of PET, PTFE, and PVC film before and after etching. Error bars represent standard deviation based on three replicate data.

Cycle Number	Discoloration 5 Hours	Kinectic Rate ( $H^{-1}$ )
1st cycle	81.94	0.00561
2nd cycle	49.90	0.00227
3rd cycle	36.60	0.00138
4th cycle	36.90	0.00151
5th cycle	33.77	0.00143

**Figure S14.** Evolution of degradation from 1 to 5 cycles of reaction.



<b>Height (um)</b>	<b>Voltage (V)</b>	<b>Height (um)</b>	<b>Voltage (V)</b>
123	0.063	160.8	0.36
124.4	0.249	161.6	0.3312
124.4	0.06	162	0.147
126.9	0.286	162.6	0.322
128.4	0.388	162.9	0.671
132.7	0.216	162.9	0.2291
133.2	0.789	163.9	0.308
133.4	0.146	164.6	0.298
135.9	0.378	164.6	0.473
136.5	0.159	165.1	0.33
137.9	0.353	165.4	0.2652
139.8	0.2612	165.8	0.536
141.9	0.2522	165.9	0.1942
142.2	0.177	166.2	0.402
145.4	0.277	166.4	0.889
146	0.2878	167.3	0.2387
146.4	0.218	167.3	0.419
146.5	0.251	167.4	0.144
146.8	0.138	168.3	0.3369
147.7	0.273	169.6	0.4251
148.4	0.296	170.8	0.4666
148.8	0.373	171.4	0.39
149.1	0.2263	172.5	0.204
149.1	0.398	173.2	0.2783
150.8	0.788	173.5	0.3957
152	0.215	173.9	0.66
152.1	0.2306	175.6	0.411
152.2	0.3251	176.8	0.3274
153	0.432	176.8	0.3056
153.5	0.3088	176.8	0.509
153.9	0.3028	177.8	0.3675

154	0.185	179.1	0.421
154.7	0.2864	179.9	0.384
154.7	0.2926	182.6	0.243
155.5	0.2207	184.1	0.5
156.3	0.222	185.5	0.2838
158.2	0.2043	185.9	0.3073
159.7	0.62	187.9	0.17
160.2	0.2521	188.2	0.383
160.4	0.249	190.9	0.471
191.3	0.361	208.3	0.147
191.6	0.859	208.7	0.428
192.7	0.272	211.5	0.892
192.9	0.373	211.8	0.332
193.8	0.306	216.9	0.3624
198.4	0.3145	219.8	0.258
202	0.3473	223	0.238
202.5	0.368	223.1	0.192
203.7	0.3748	225.7	0.42
206.4	0.504	226.8	0.438

**Table S1** Summary of Potential difference depend on height between peak and bottom. All measurements were randomly selected in four different films.