SUPPORTING INFORMATION PARAGRAPH

A Sensor Array Using Multi-functional Field-effect Transistors with Ultrahigh Sensitivity and Precision for Bio-monitoring

Do-Il Kim[1], Tran Quang Trung[1], Byeong-Ung Hwang[1], Jin-Su Kim[1], Sanghun Jeon[3], Jihyun Bae[4], Jong-Jin Park[5]& Nae-Eung Lee[1,2],*

[1]School of Advanced Materials Science & Engineering, Sungkyunkwan University, Suwon, Kyunggi-do 440-746, Republic of Korea.

[2]SKKU Advanced Institute of Nano Technology (SAINT), Sungkyunkwan University, Suwon, Kyunggi-do 440-746, Republic of Korea

[3]Department of Applied Physics, Korea University, Sejongro 2511, Sejong 339-700, Korea

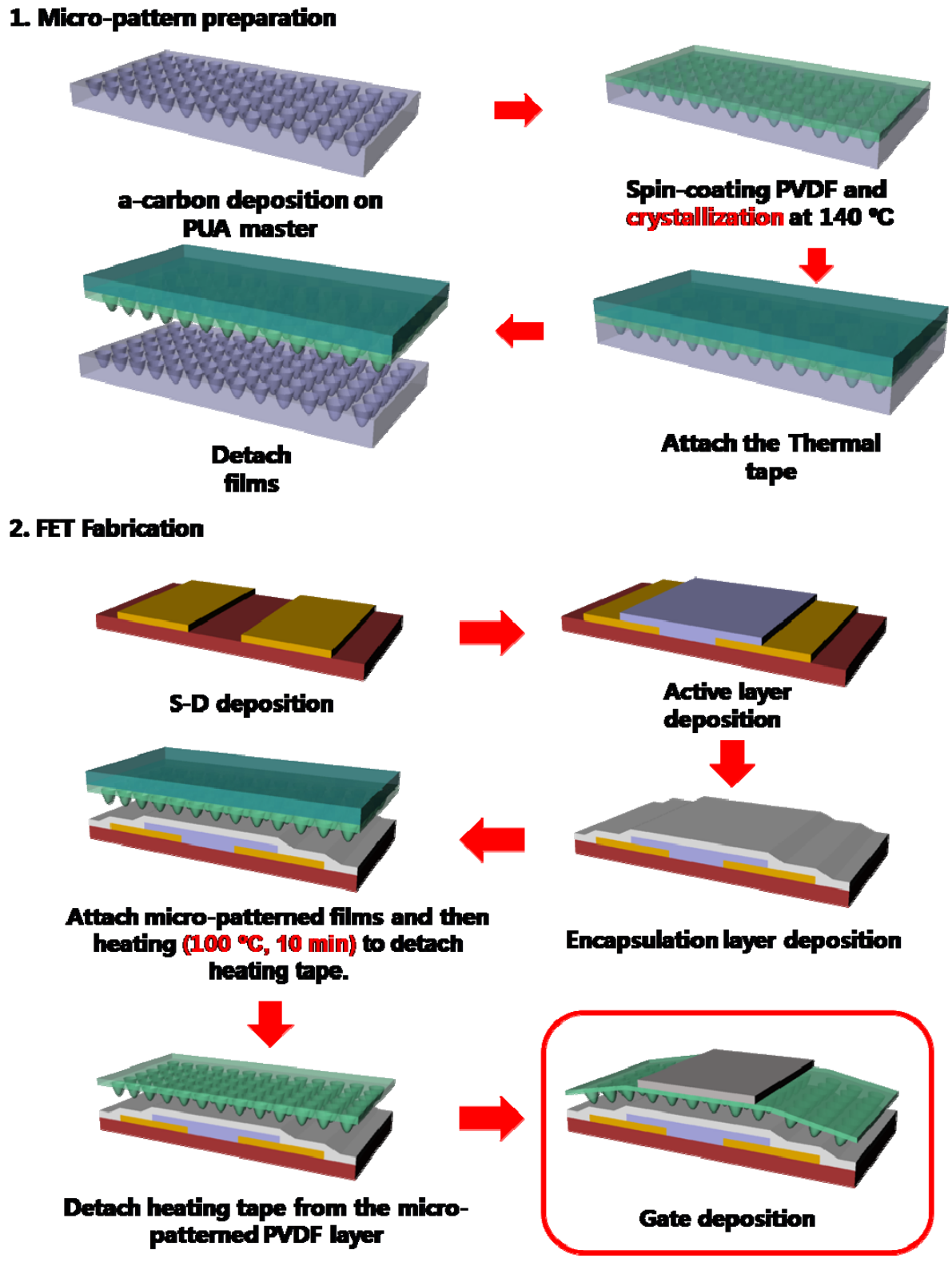
[4]Samsung Advanced Institute of Technology, Samsung Electronics Corporation, Yongin, Kyunggi-do 446-712, Republic of Korea

[5]School of Polymer Science & Engineering, Chonnam National University, Gwangju 500-757, Korea

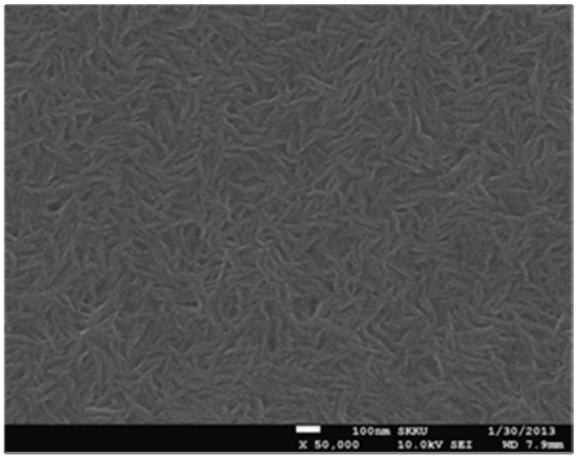
**E-mail: nelee@skku.edu*

Supporting Figure S1:

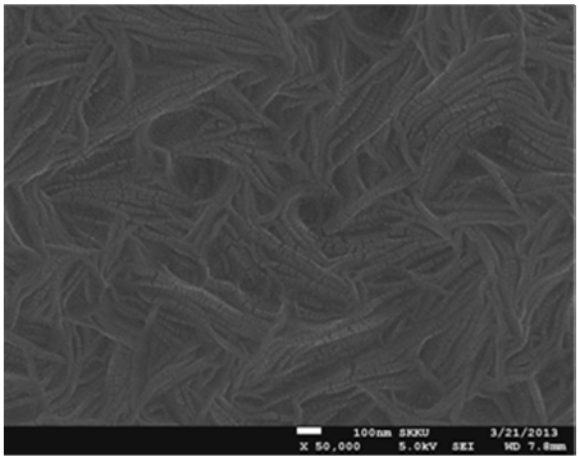
The process flow for manufacturing a microstructured FET sensor



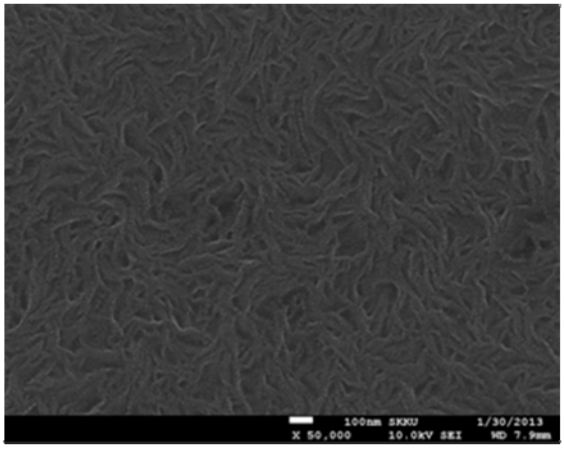
Supporting Figure S2:



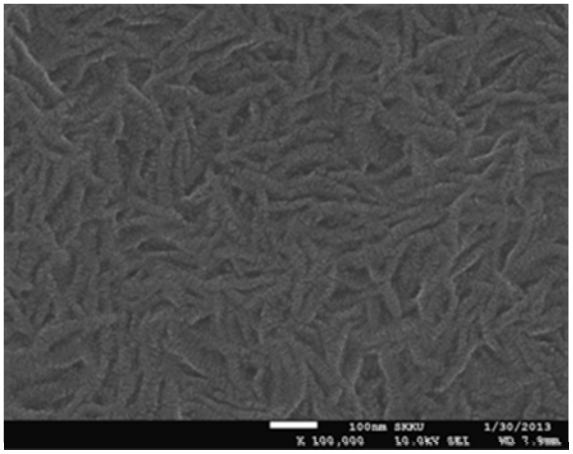
2 hours



4 hours



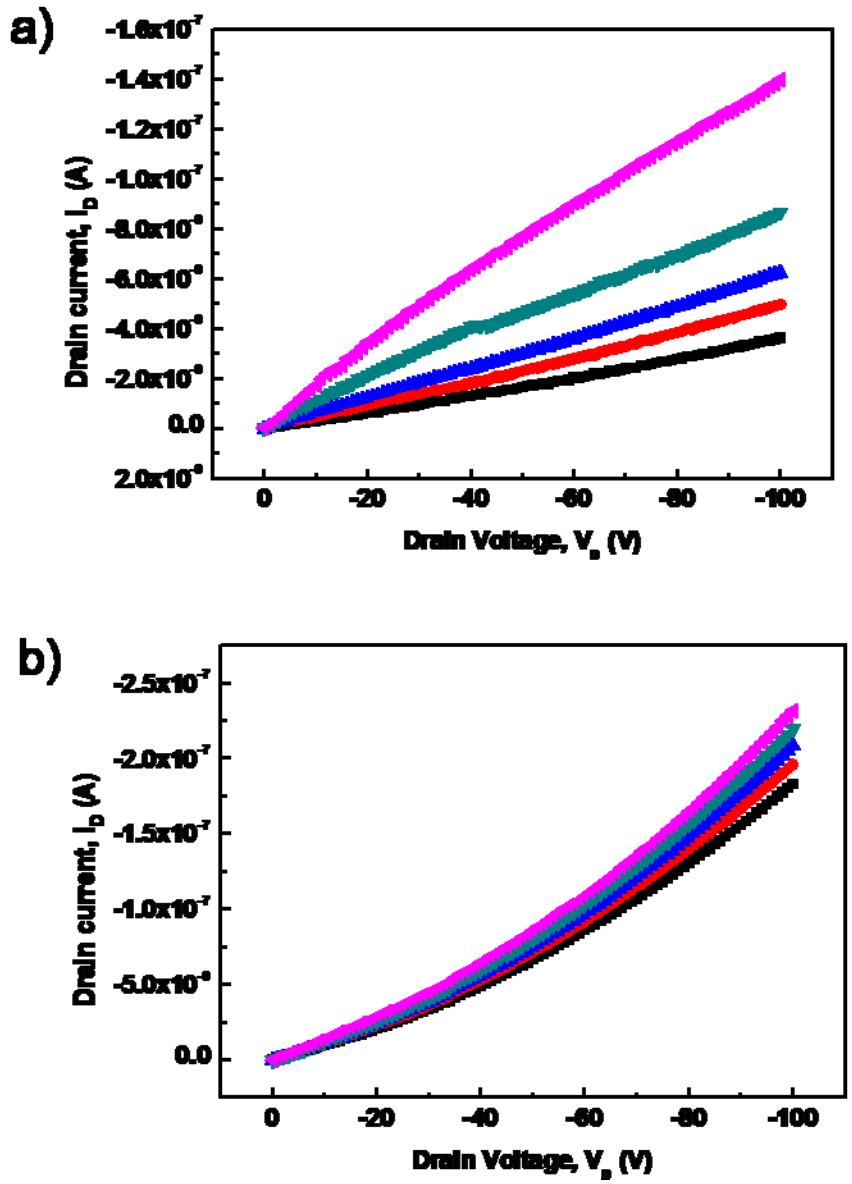
6 hours



8 hours

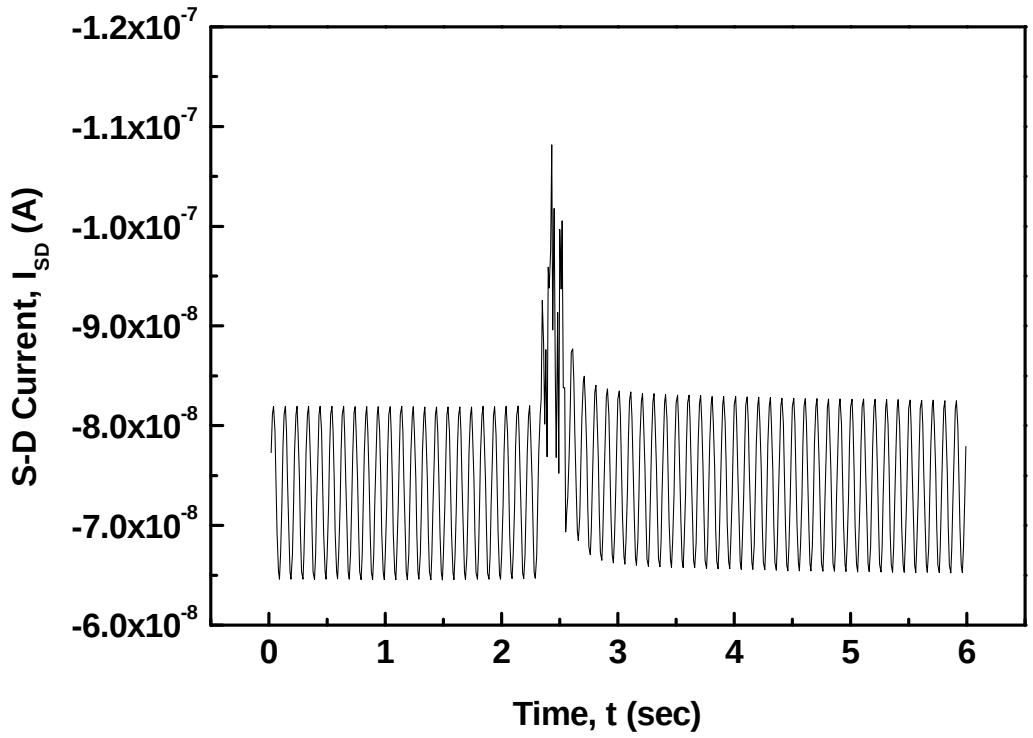
FE-SEM images of thick P(VDF_TrFE) microstructures formed at 140 °C with varying annealing time.

Supporting Figure S3:



Output characteristics of a microstructured FET sensor (a) before poling and (b) after poling by being biased V_G of -100 V

Supporting Figure S4:



Measured I_D while being biased by AC gate voltage of -20 V at frequency of 10 Hz with applying pressure of 0.3 kPa.

Supporting Table S1:

	M_1 [pS/kPa]	M_2 [pS/K]	M_3 [V/MPa]	M_4 [V/K]
P(VDF-TrFE) thin film	2.9 ± 0.03	345.2 ± 2.6	5.02 ± 0.042	-2.27 ± 0.082
P(VDF-TrFE) microstructure	44.2 ± 0.28	342.1 ± 3.4	14.07 ± 0.055	-2.06 ± 0.043

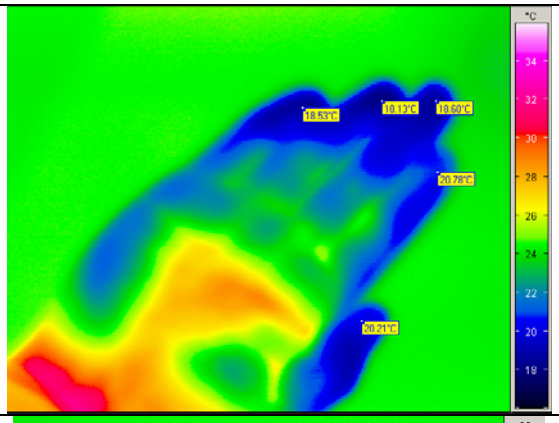
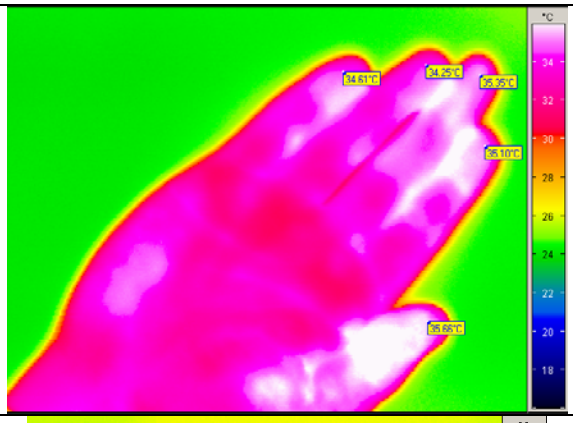
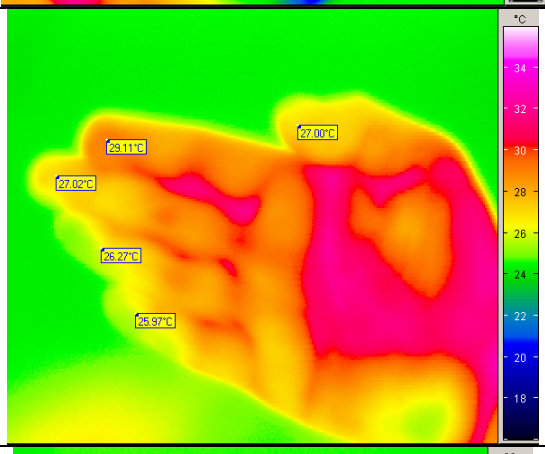
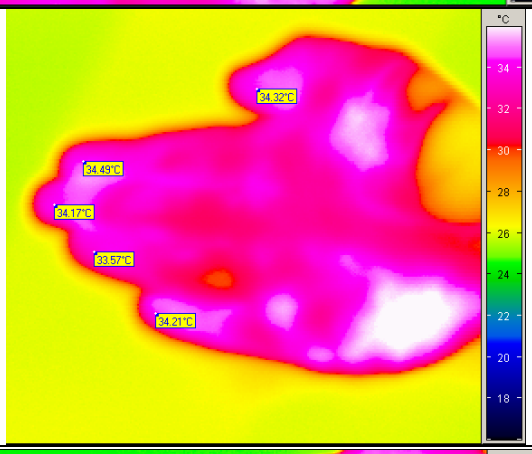
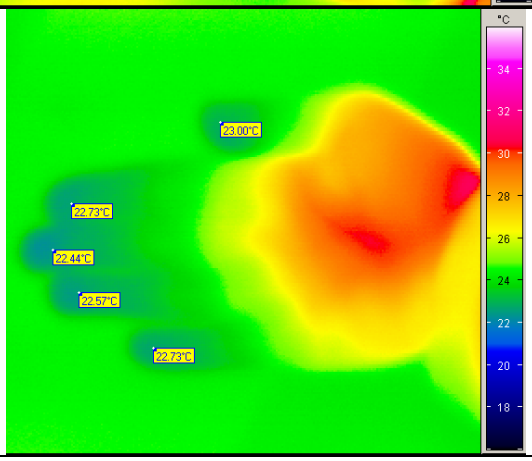
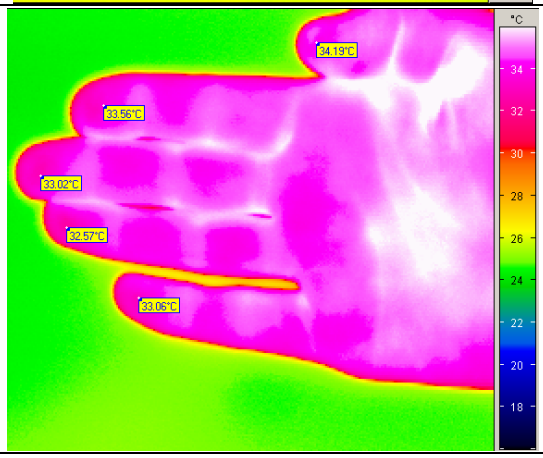
Extracted M values of FETs using P(VDF_TrFE) microstructure and thin film. M_1, M_2 : Piezo-resistive and thermal-resistive coefficient of pentacene organic semiconductors respectively, M_3, M_4 : Piezoelectric and pyroelectric coefficient of gate dielectrics respectively.

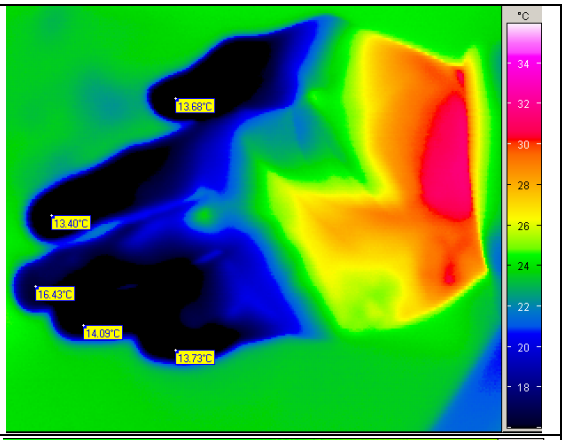
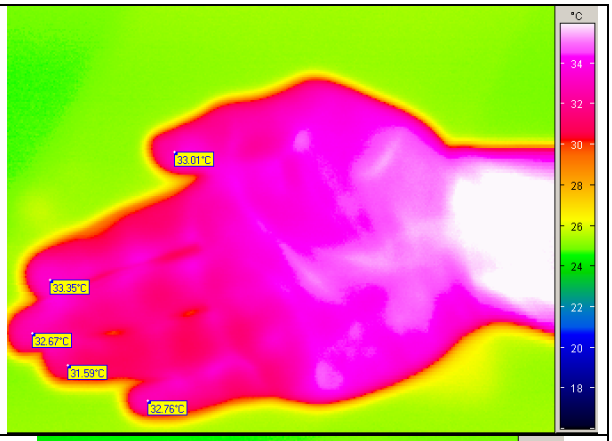
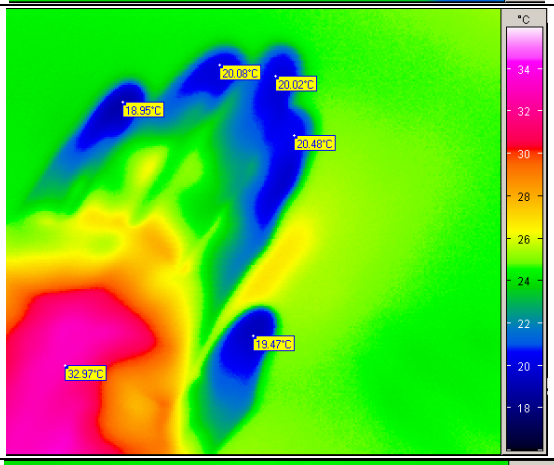
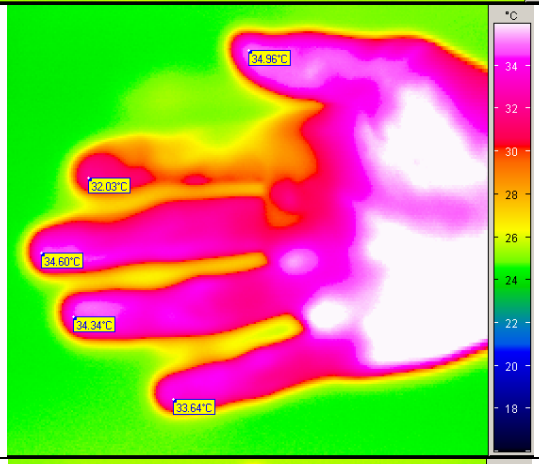
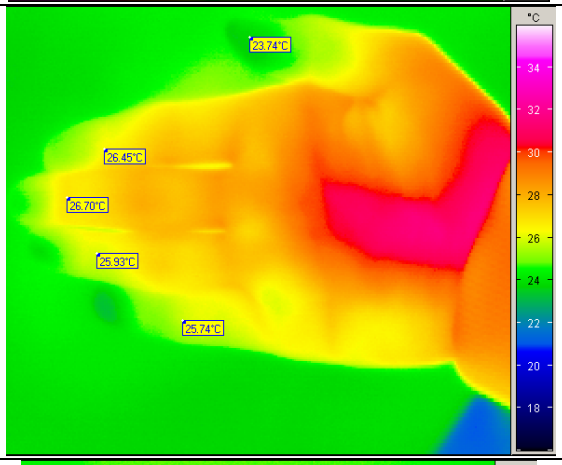
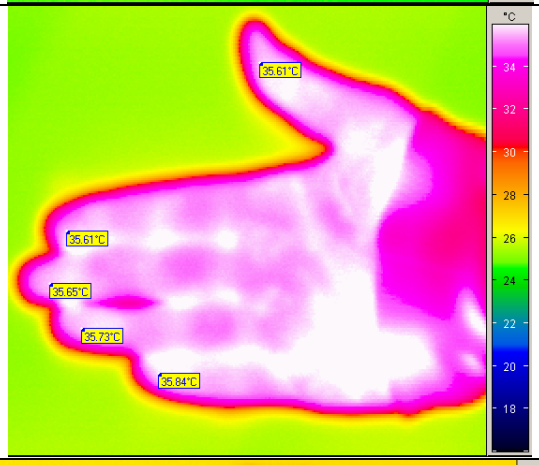
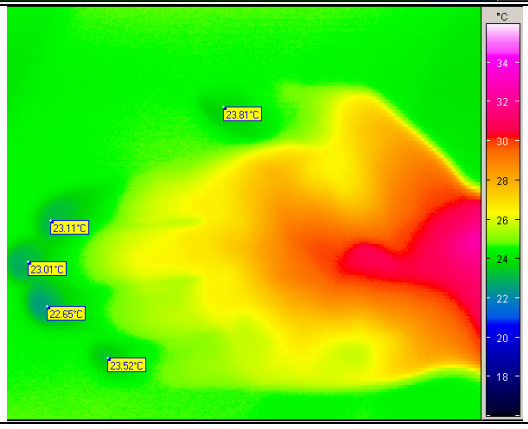
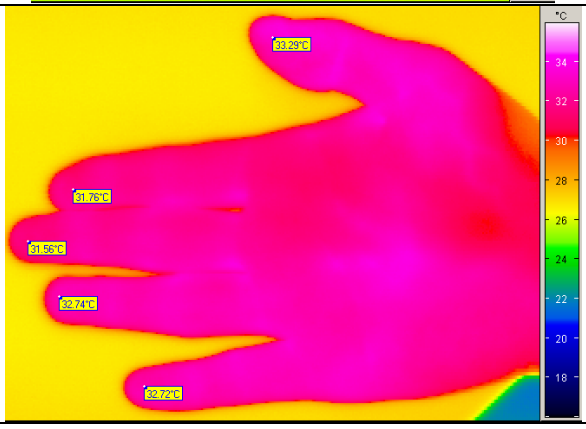
Supporting Table S2:

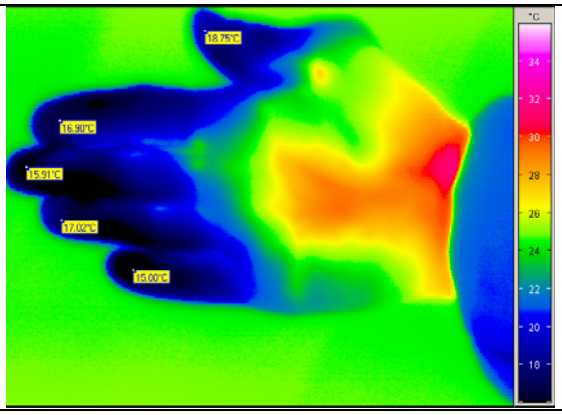
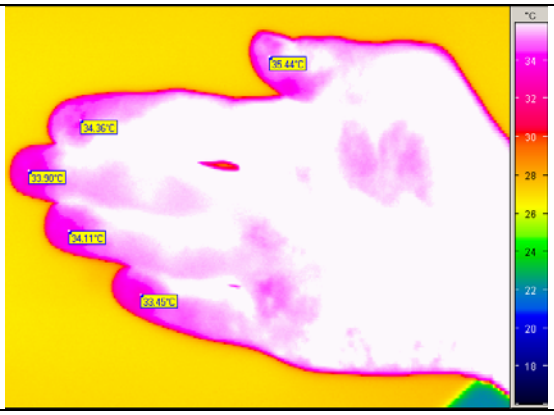
Subject order	Sex	age	Thumb temperature outdoors (°C)	Thumb temperature indoors (°C)
1	Male	27	20.2	35.6
2	Male	27	27.0	34.3
3	Female	26	23.0	34.2
4	Male	24	13.7	33.0
5	Male	28	19.5	35.0
6	Male	26	23.7	35.6
7	Male	27	23.8	33.3
8	Male	25	18.8	35.4

Extracted temperature values of subject's thumb from IR images measured by an IR camera indoors and outdoors (indoor temperature: 24°C, outdoor temperature: 3°C). Average values of thumb's temperatures indoors and outdoors were calculated as 21.2°C and 34.6°C respectively.

Supporting Table S3:

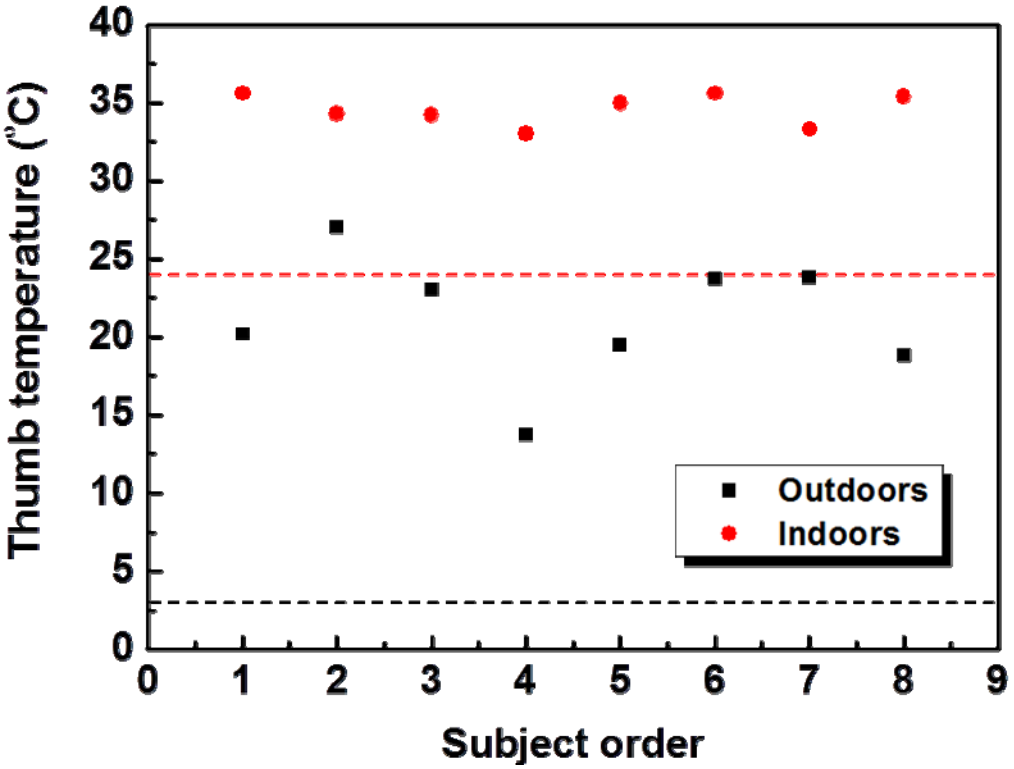
	Outdoors	indoors
1		
2		
3		

4	 13.68°C 13.40°C 16.43°C 14.08°C 13.73°C °C 34 32 30 28 26 24 22 20 18	 33.01°C 33.35°C 32.67°C 31.59°C 32.76°C °C 34 32 30 28 26 24 22 20 18
5	 20.09°C 20.02°C 18.95°C 20.48°C 19.47°C 32.97°C °C 34 32 30 28 26 24 22 20 18	 34.96°C 32.03°C 34.60°C 34.34°C 33.64°C °C 34 32 30 28 26 24 22 20 18
6	 28.74°C 26.45°C 26.70°C 25.93°C 25.74°C °C 34 32 30 28 26 24 22 20 18	 35.61°C 35.61°C 35.65°C 35.73°C 35.84°C °C 34 32 30 28 26 24 22 20 18
7	 23.81°C 23.11°C 23.01°C 22.65°C 23.52°C °C 34 32 30 28 26 24 22 20 18	 33.29°C 31.76°C 31.56°C 32.74°C 32.72°C °C 34 32 30 28 26 24 22 20 18

8		

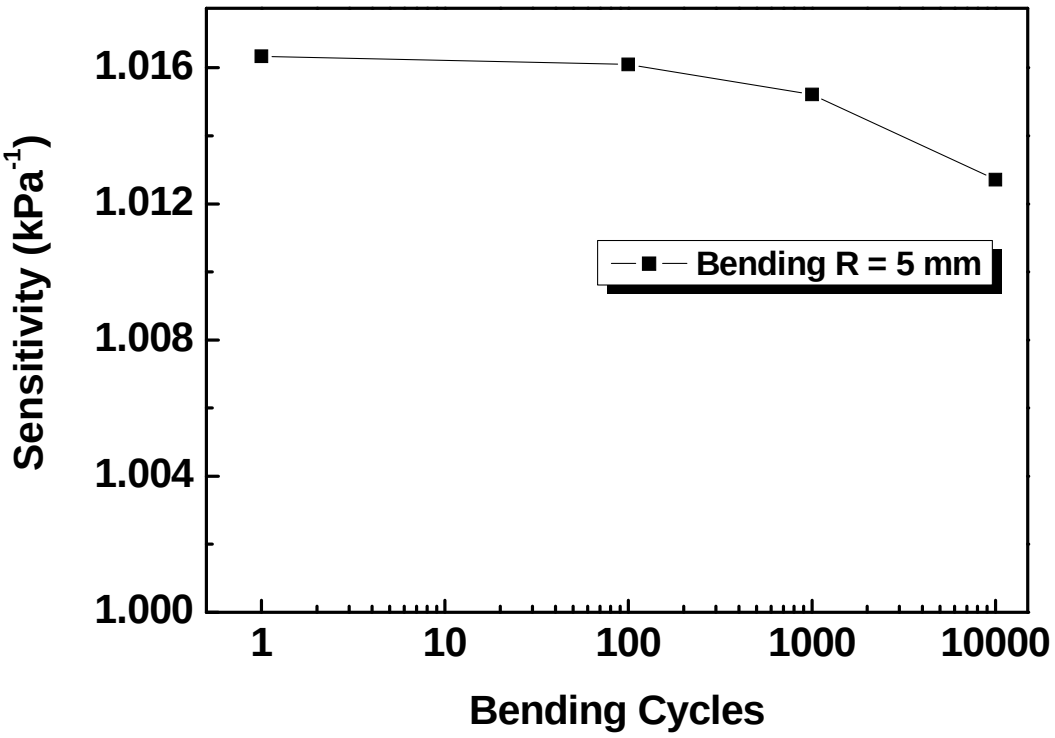
IR images of subject's palm measured by an IR camera indoors and outdoors after calibration using a thermocouple in the heated metal block.

Supporting Figure S5:



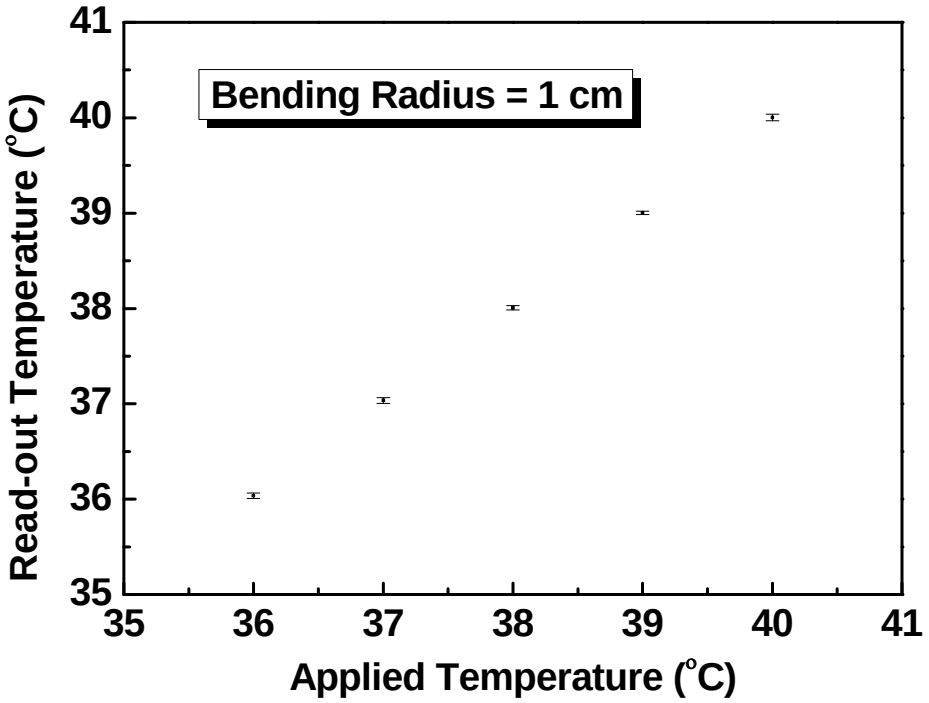
Extracted temperatures of the subject's thumbs from IR images measured by an IR camera indoors and outdoors (red and black dotted lines indicate temperatures measured indoors and outdoors, respectively).

Supporting Figure S6:



Evaluated sensitivity of microstructure OFET sensors with increasing bending cycles at the bending radius of 5 mm.

Supporting Figure S7:



Extracted read-out temperatures under the bent state at bending radius of 1 cm. Error bars indicate the standard deviation of this temperature measurement.