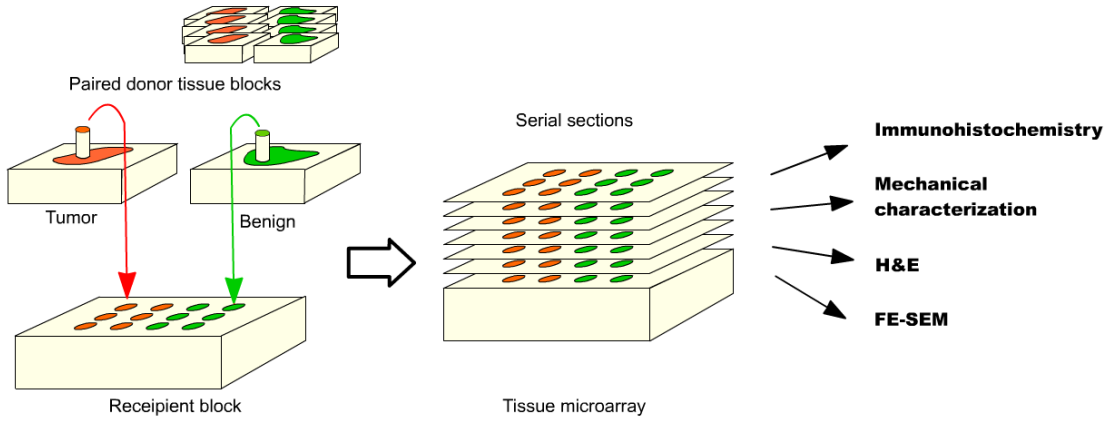
Electronic Supplementary Material (ESI) for Lab on a Chip.
This journal is © The Royal Society of Chemistry 2014

Mechanical phenotyping of breast cancer using MEMS: A method to demarcate benign and cancerous breast tissue

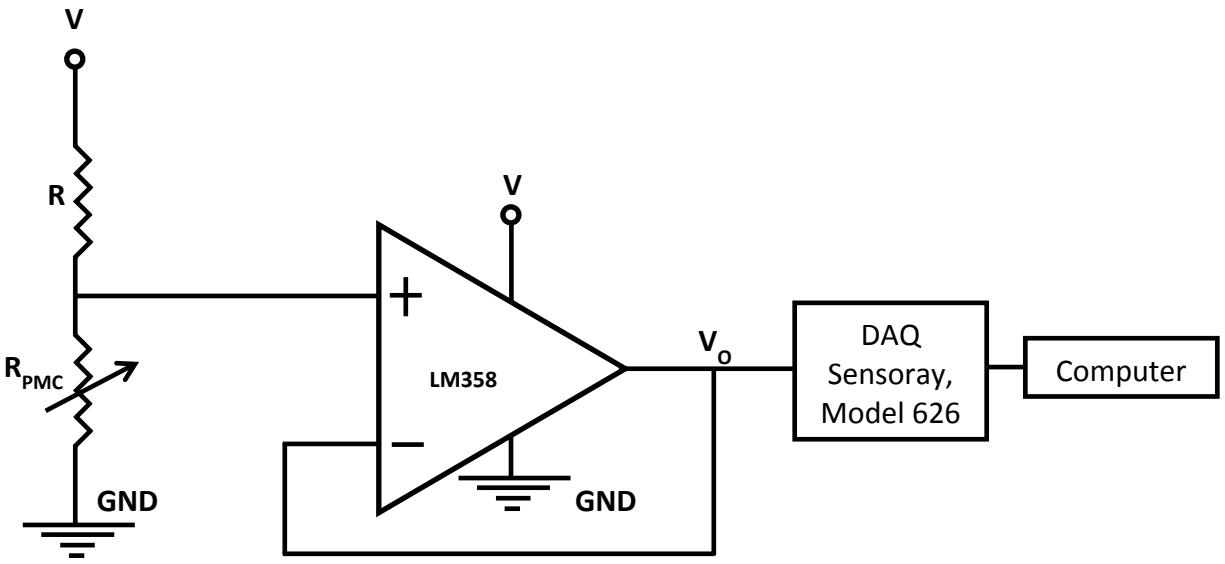
Hardik J. Pandya[a,*], Wenjin Chen[b], Lauri A. Goodell[c], David J. Foran[b] and Jaydev P. Desai[a]

* Correspondence to: hjpandya@umd.edu

Supplementary Methods



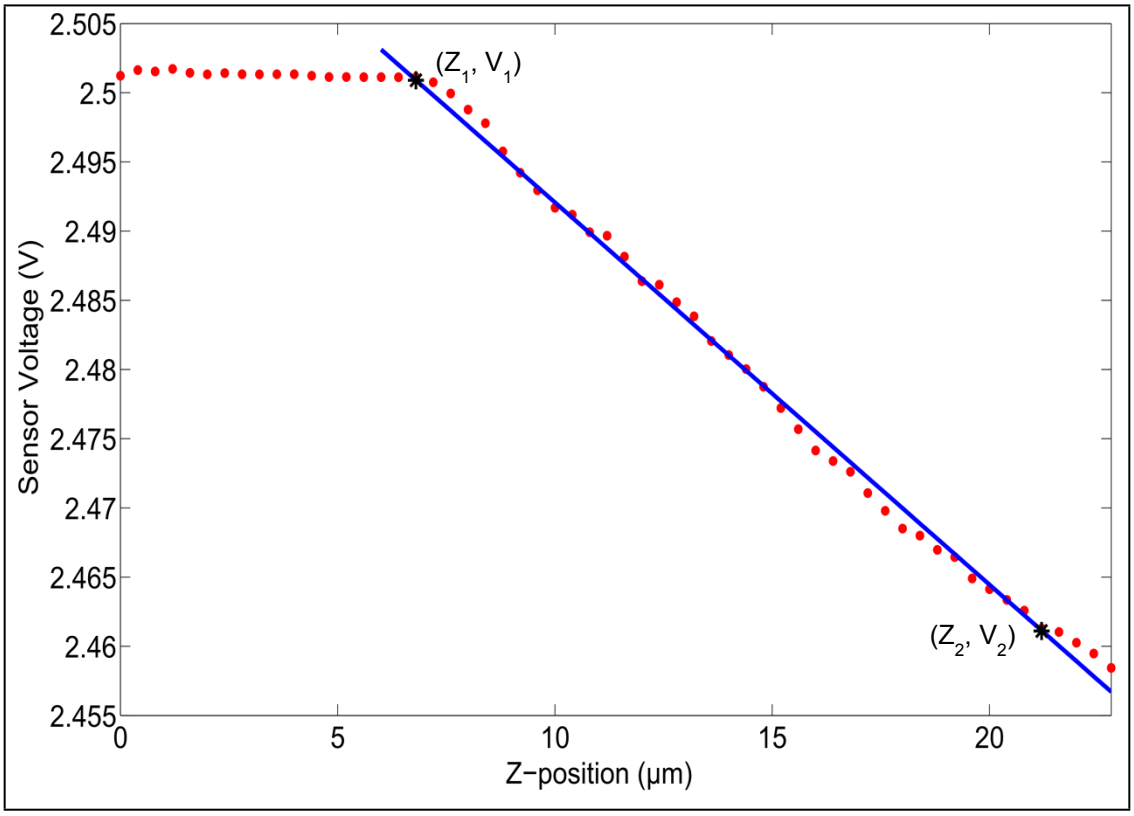
Supplementary Fig. S1. Sample TMA preparation. Various slices are prepared for Immunohistochemistry, mechanical characterization, H&E staining, and FE-SEM imaging.



Supplementary Fig. S2. Electronic module. Displaying PMC output on computer.

The output voltage Vo fed to DAQ card was calculated as:

$$V_o = \frac{R_{PMC}}{(R + R_{PMC})} x\ V \qquad (1)$$



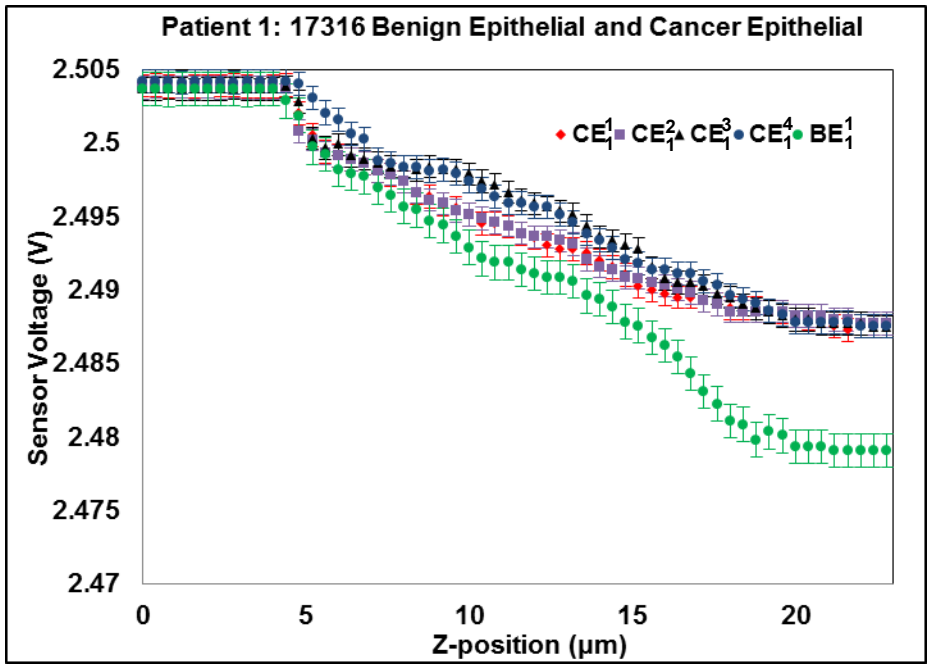
Supplementary Fig. S3. Sensitivity measurement of the fabricated piezoresistive microcantilever. Measuring change in voltage (V) as a function of the vertical distance (Z).

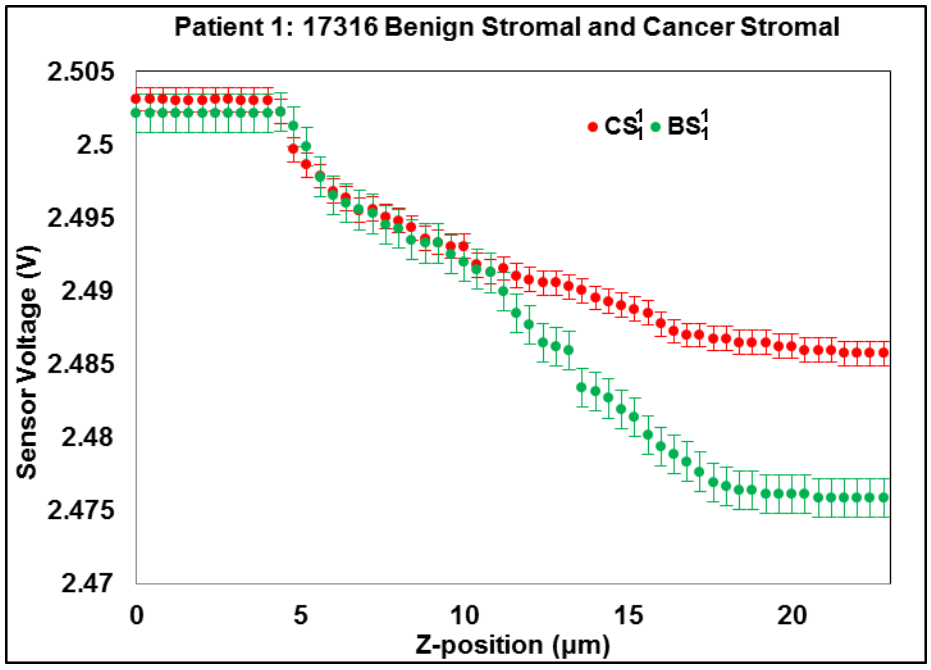
A linear regression model was used to find the correlation between the changes in the sensor reading to the sensor displacement. The goodness of fit (R^2 value) was found to be 0.9956, which shows that the sensor has a linear response. The sensitivity of the sensor is given by:

$$S = \frac{V_2 - V_1}{Z_2 - Z_1} = \frac{\Delta V}{\Delta Z} = \; - \; 0.0027 \text{ V/μm}$$

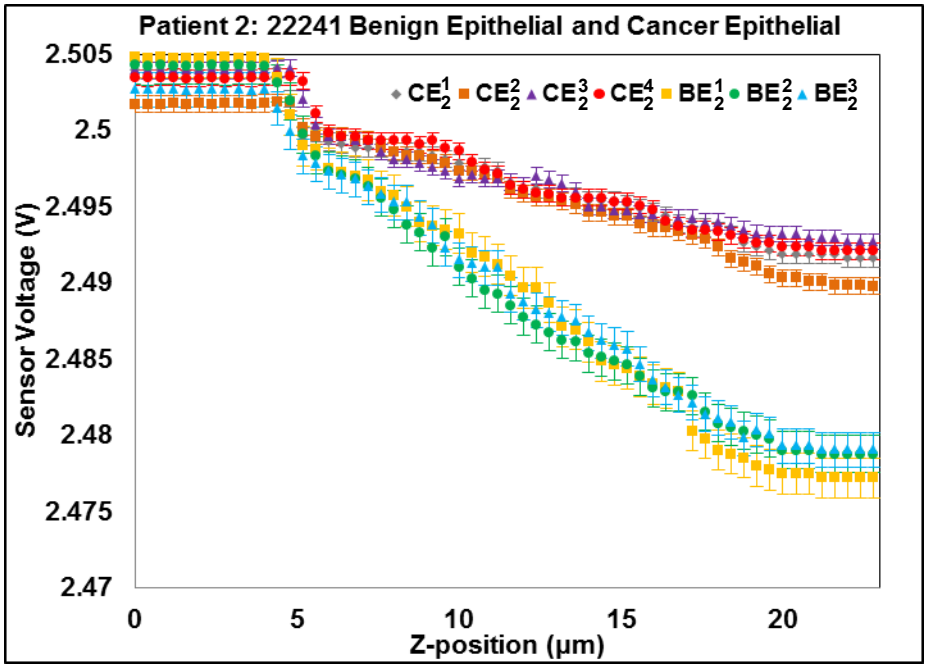
where, Z_1, Z_2, V_1, and V_2 are 6.8μm, 21.2μm, 2.5011V, and 2.4612V respectively.

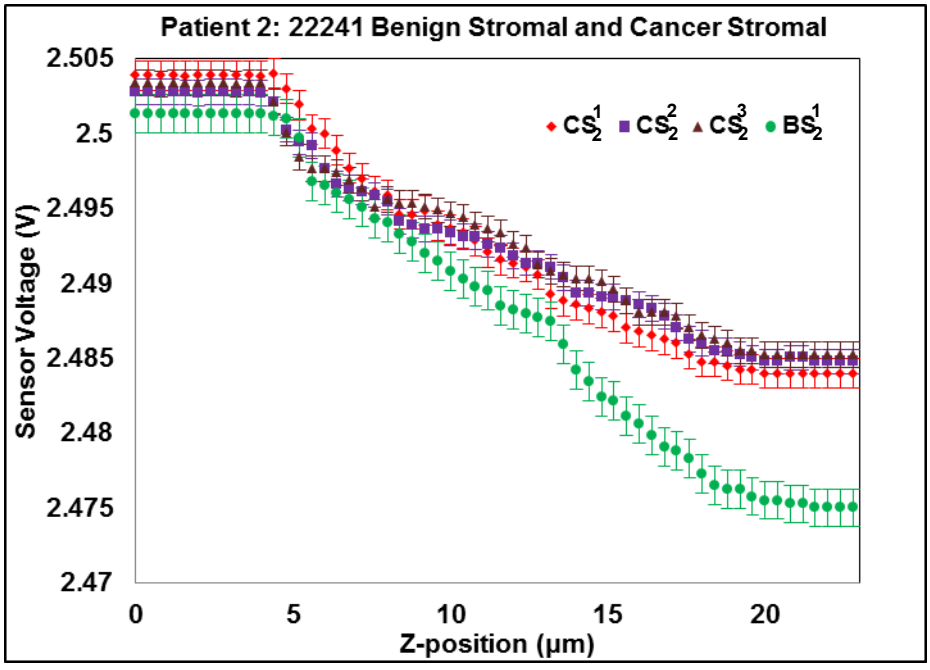
A


Patient 1: 17316 Benign Epithelial and Cancer Epithelial
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CE_1^1 CE_1^2 CE_1^3 CE_1^4 BE_1^1

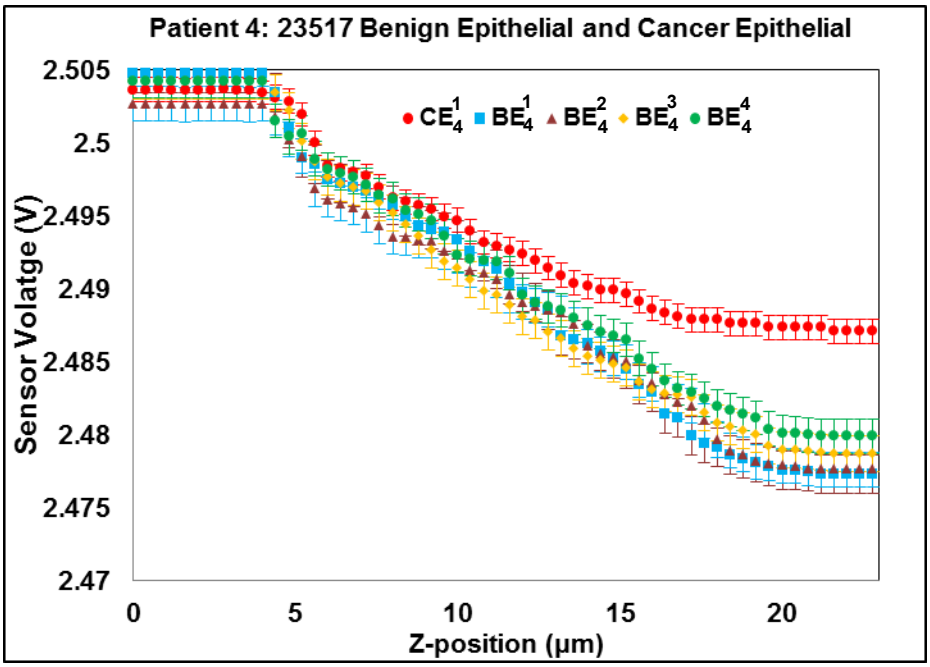

Patient 1: 17316 Benign Stromal and Cancer Stromal
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CS_1^1 BS_1^1

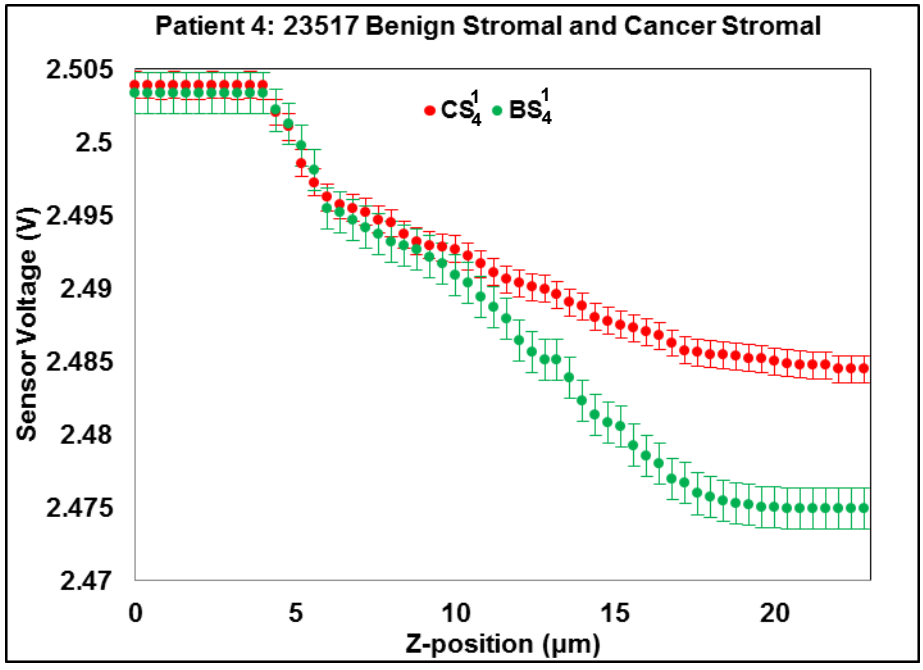
B


Patient 2: 22241 Benign Epithelial and Cancer Epithelial
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CE_2^1 CE_2^2 CE_2^3 CE_2^4 BE_2^1 BE_2^2 BE_2^3

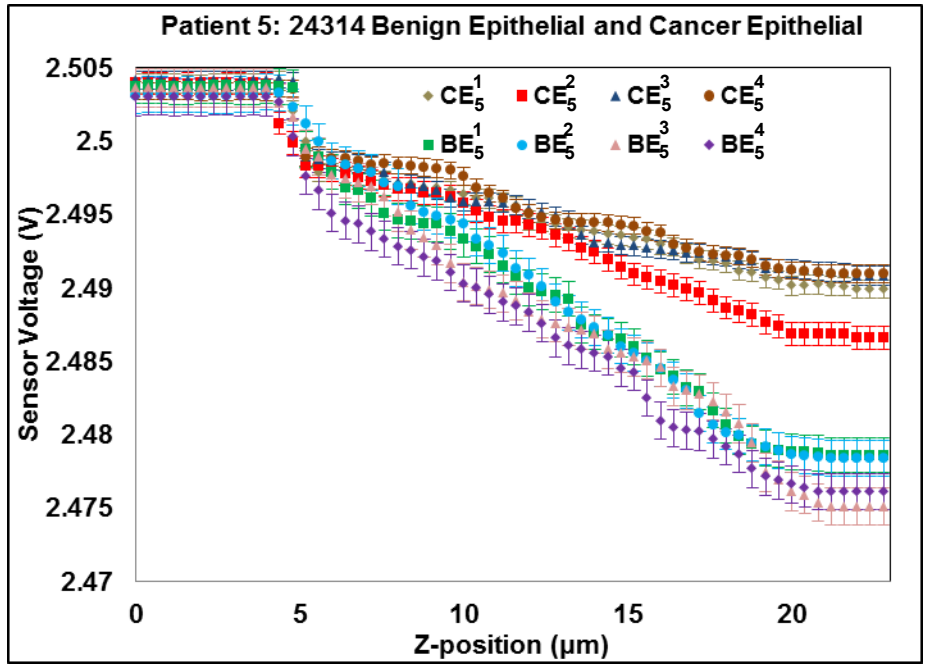

Patient 2: 22241 Benign Stromal and Cancer Stromal
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CS_2^1 CS_2^2 CS_2^3 BS_2^1

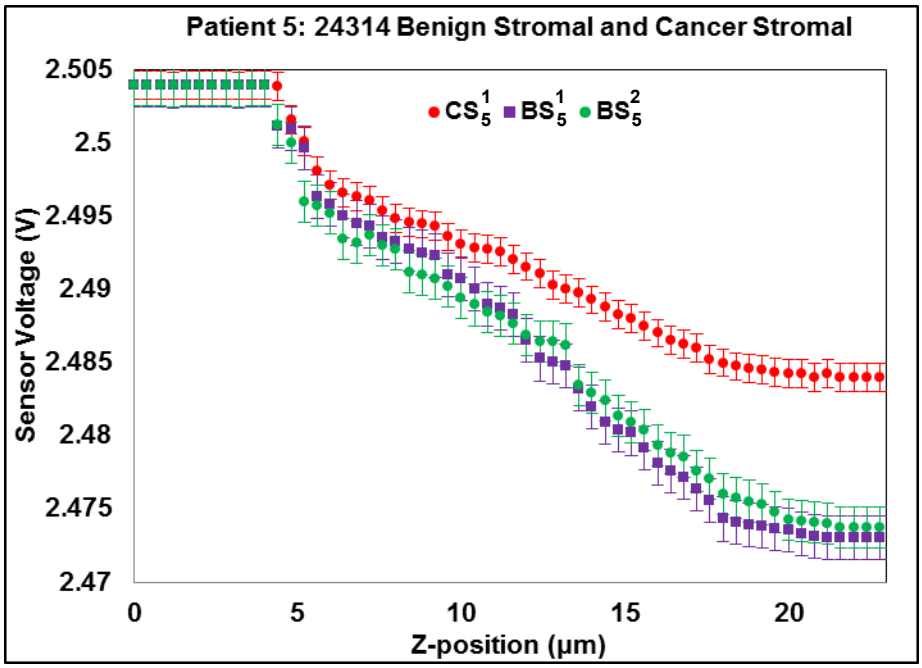
C


Patient 4: 23517 Benign Epithelial and Cancer Epithelial
Sensor Volatge (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CE_4^1 BE_4^1 BE_4^2 BE_4^3 BE_4^4

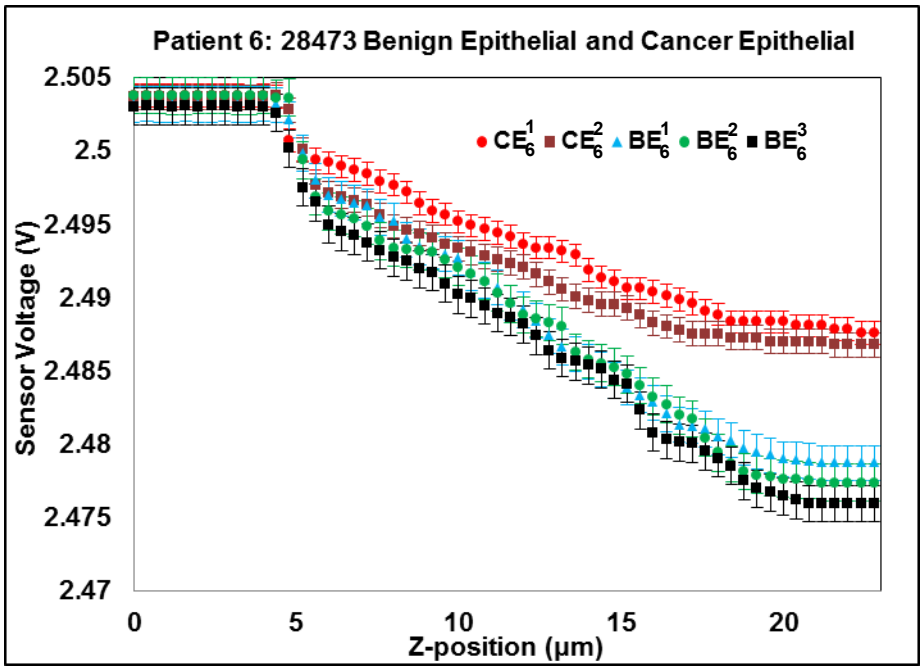

Patient 4: 23517 Benign Stromal and Cancer Stromal
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CS_4^1 BS_4^1

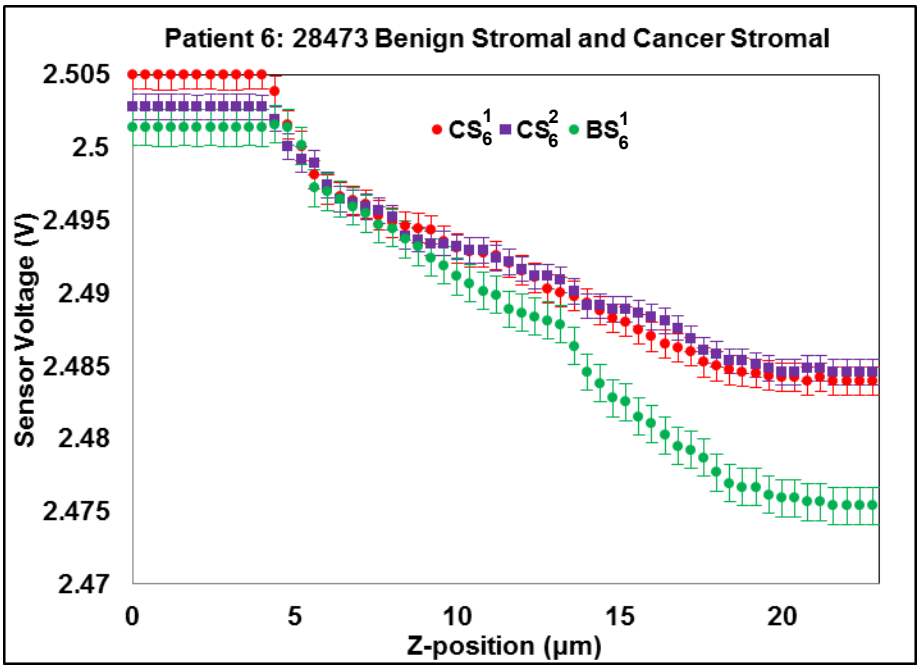
D


Patient 5: 24314 Benign Epithelial and Cancer Epithelial
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CE_5^1 CE_5^2 CE_5^3 CE_5^4
BE_5^1 BE_5^2 BE_5^3 BE_5^4

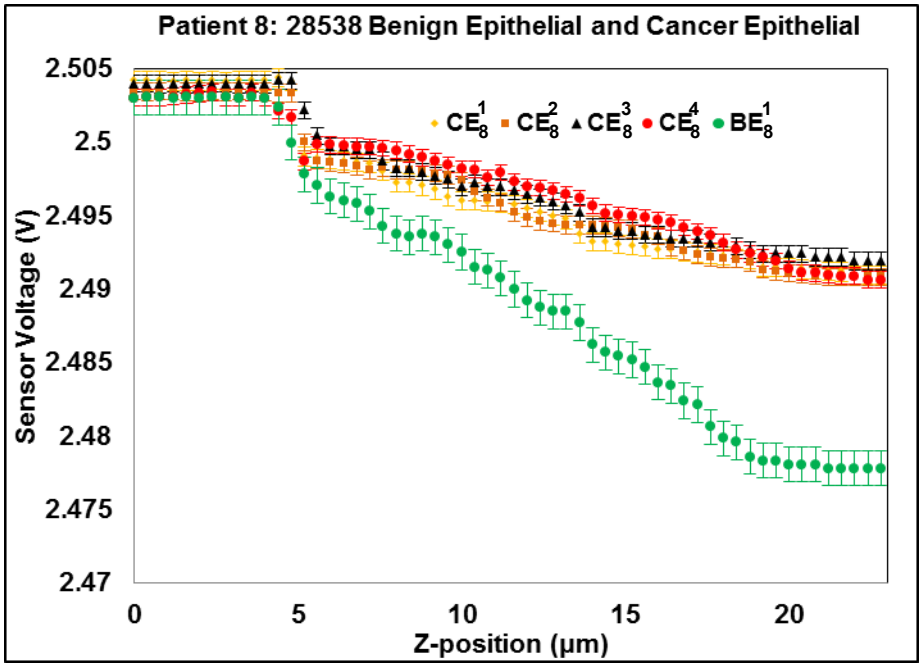

Patient 5: 24314 Benign Stromal and Cancer Stromal
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CS_5^1 BS_5^1 BS_5^2

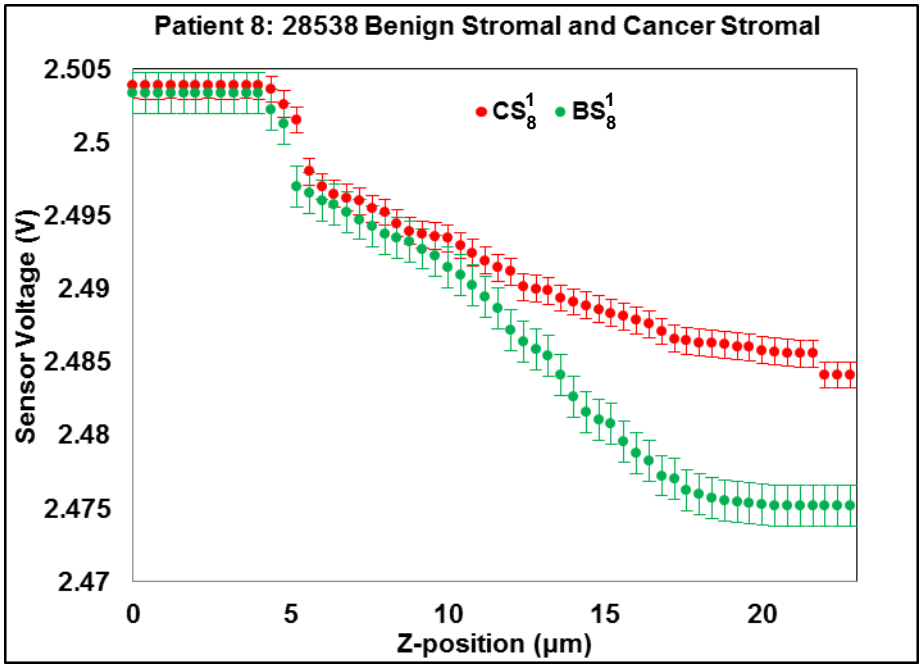
E


Patient 6: 28473 Benign Epithelial and Cancer Epithelial
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CE_6^1 CE_6^2 BE_6^1 BE_6^2 BE_6^3


Patient 6: 28473 Benign Stromal and Cancer Stromal
Sensor Voltage (V)
2.505
2.5
2.495
2.49
2.485
2.48
2.475
2.47
0
5
10
15
20
Z-position (μm)
CS_6^1 CS_6^2 BS_6^1

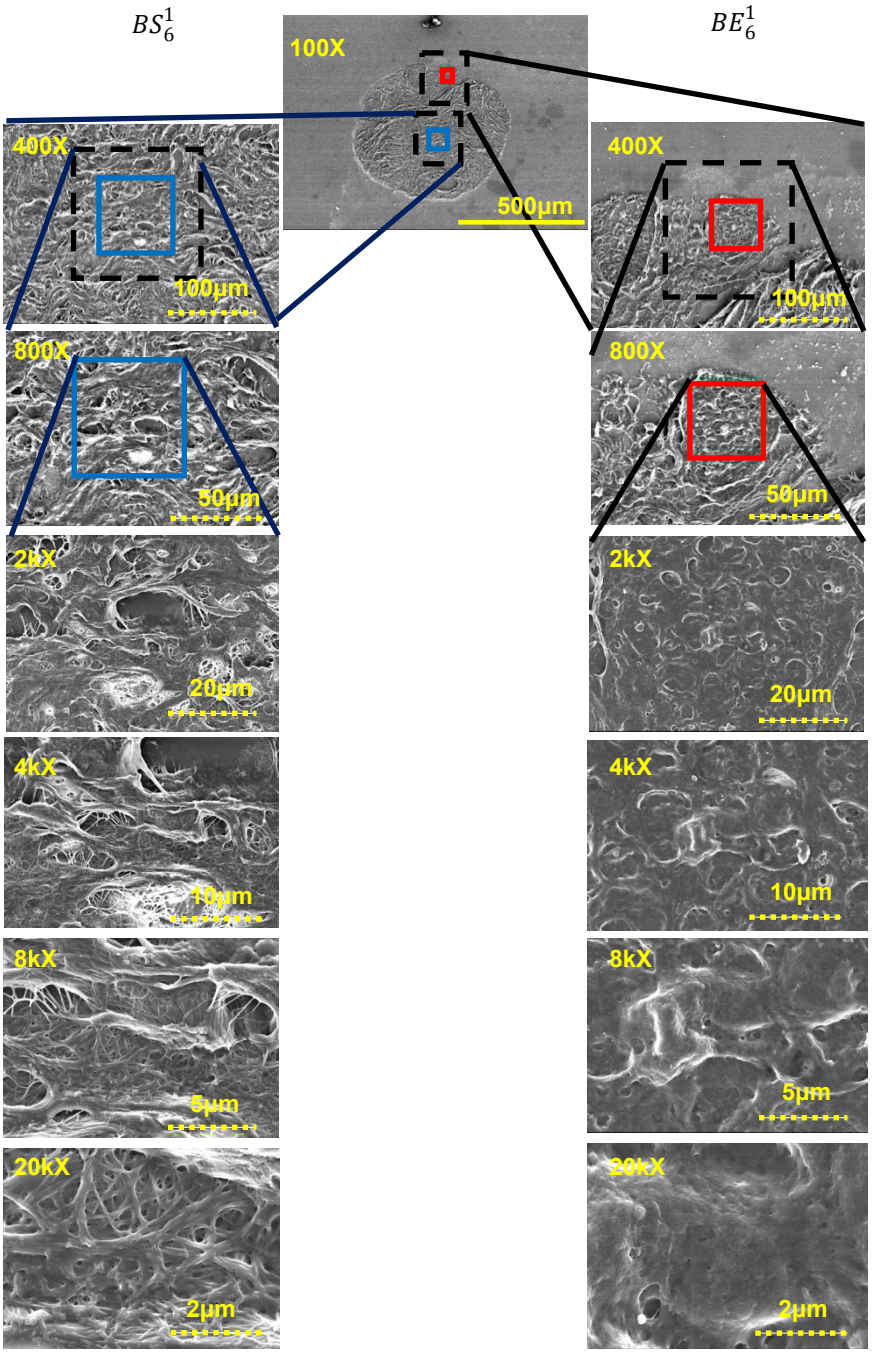
F



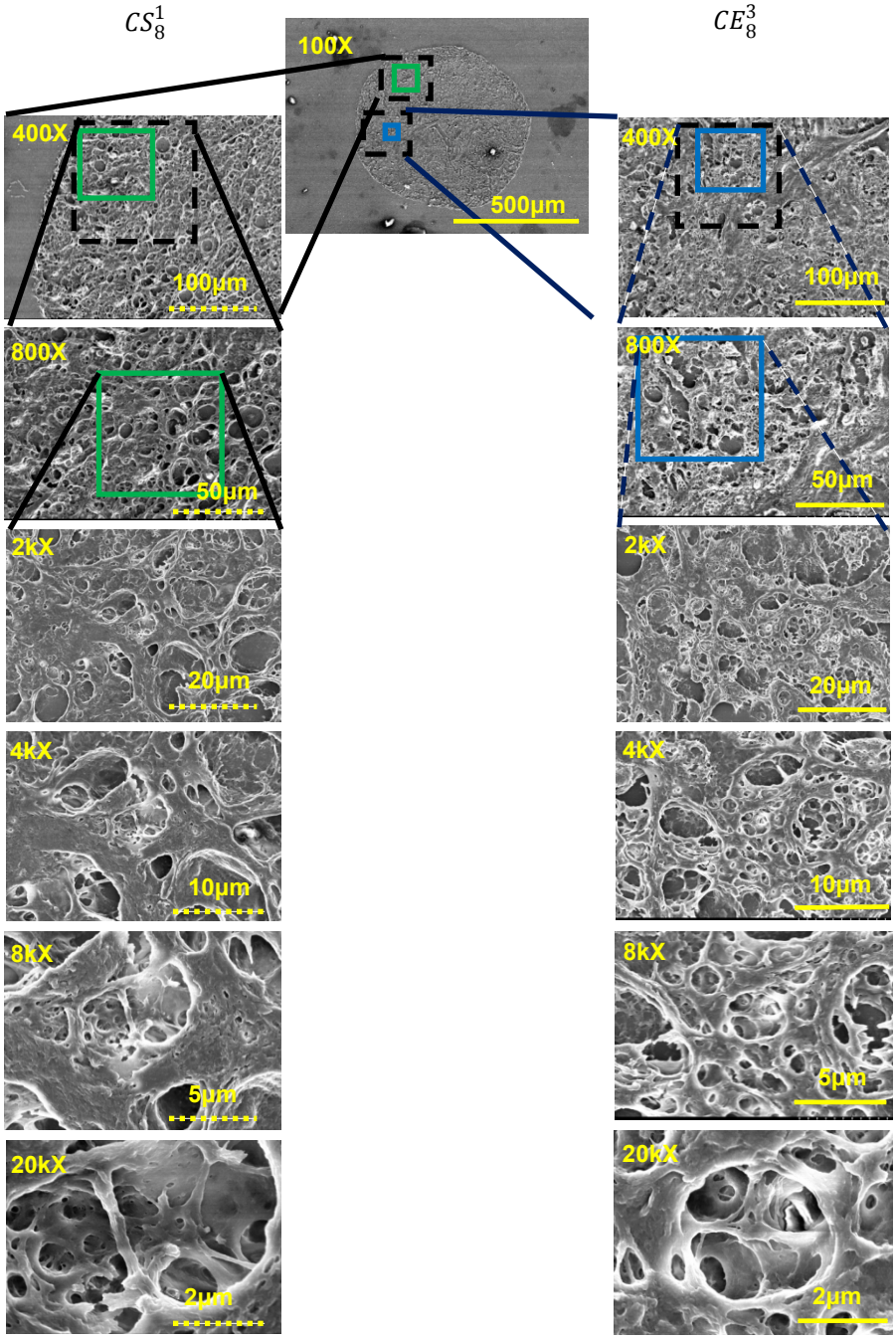


Supplementary Fig. S4. Response of sensor on indenting epithelial and stromal regions of benign and cancerous breast tissue cores. A, patient 1, **B**, patient 2, **C**, patient 4, **D**, patient 5, **E**, patient 6, and **F**, patient 8.

A


BS_6^1
BE_6^1
100X
500μm
400X
100μm
800X
50μm
2kX
20μm
4kX
10μm
8kX
5μm
20kX
2μm
400X
100μm
800X
50μm
2kX
20μm
4kX
10μm
8kX
5μm
20kX
2μm

B



Supplementary Fig. S5. FE-SEM of benign and cancerous breast tissue (A) specimen 6 and (B) specimen 8 at different magnifications. Studying microstructural changes from benign to cancer in Stromal and Epithelial region.