Metastatic Breast Cancer Health Disparities: Importance of the Extracellular Matrix Interface

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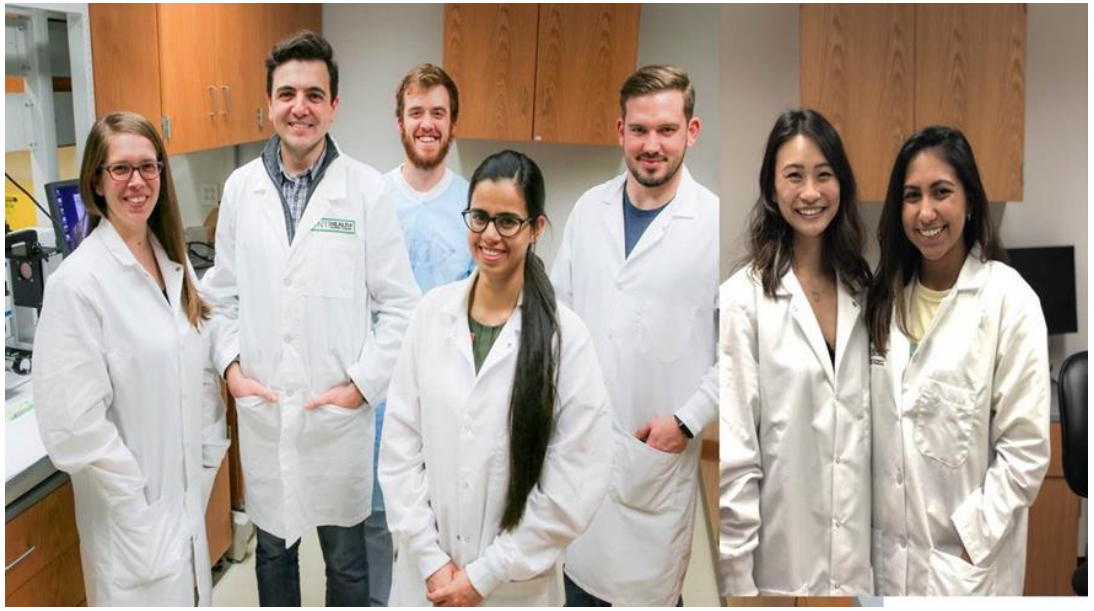
Overview

1. Background
2. Health disparity: African American women and breast cancer metastasis
3. Understanding the role of extracellular matrix in the health disparity
4. Diagnostic test to pair patient with appropriate therapy to mitigate disparity

Background

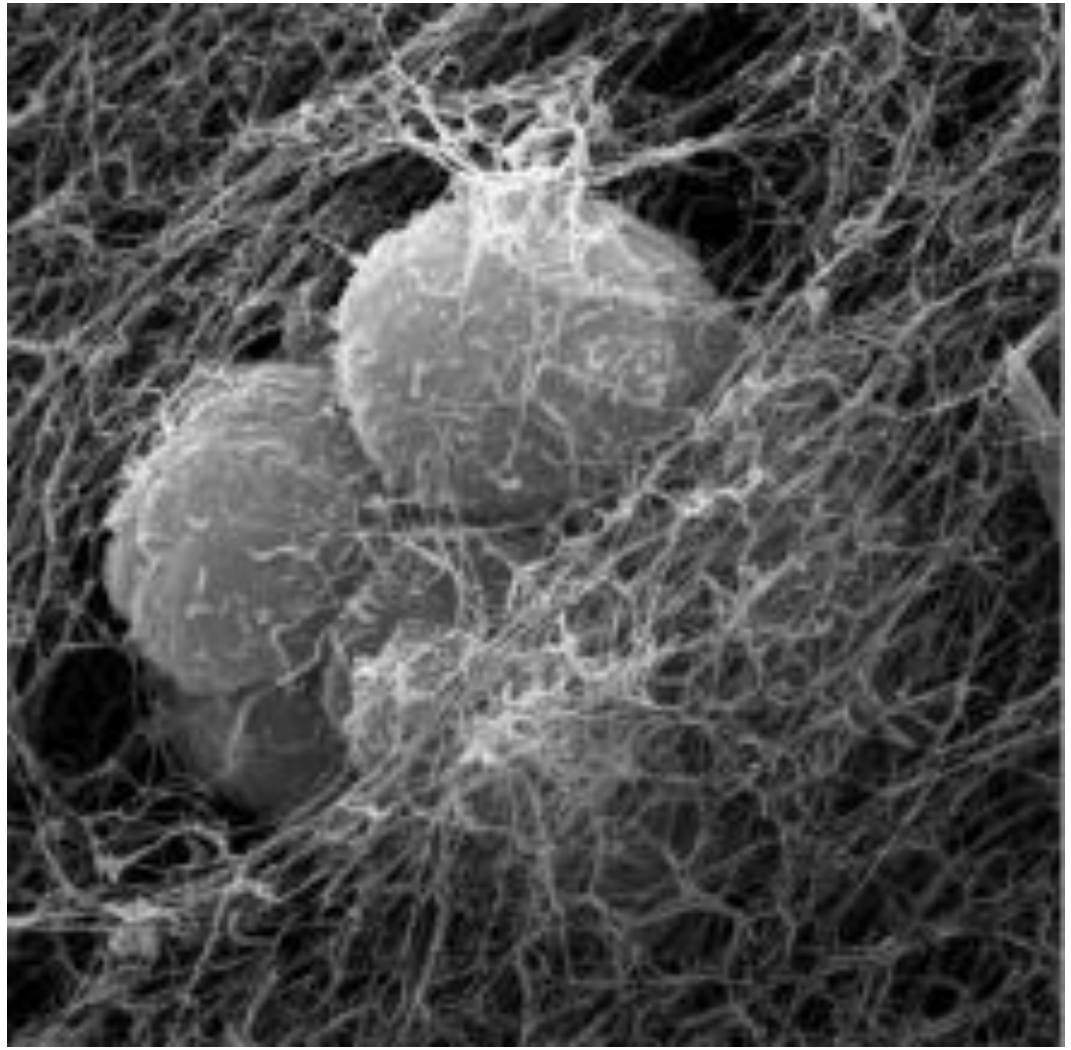
- Drug Delivery and Pharmaceutical Research on complex dosage form development
- Medical diagnostic devices
- Cancer, diabetes, glaucoma, metabolic monitoring



The Health Disparity

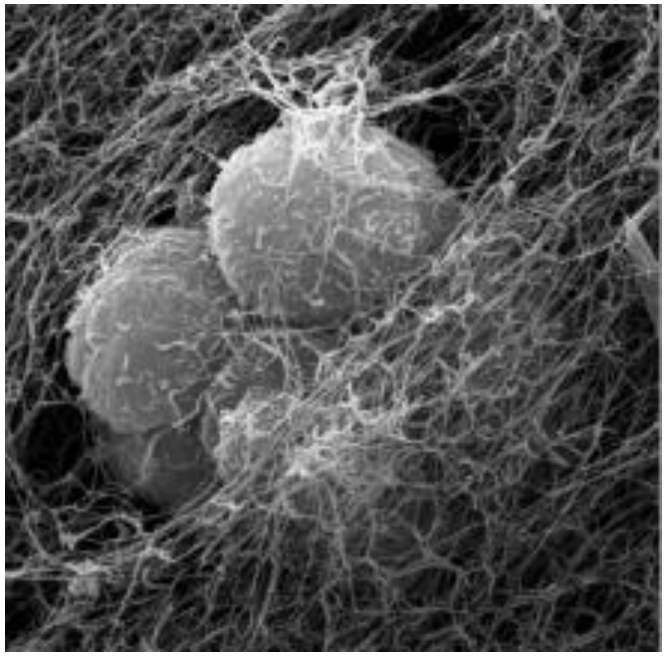
- African American women suffering from breast cancer 1.61 times more likely to develop metastasis
- Identified as a high risk group for breast cancer by the American College of Radiology
- Exact etiology unclear
  - Socioeconomic factors
  - Biological factors

Etiology



Etiology

- One biological factor identified: differences in the extracellular matrix (ECM)
- Fiber matrix that holds tumor together
- Breast cancer ECM in African American women more aggressive against cancer cells
    - Backfires: only most aggressive cells survive, that are more likely to metastasize

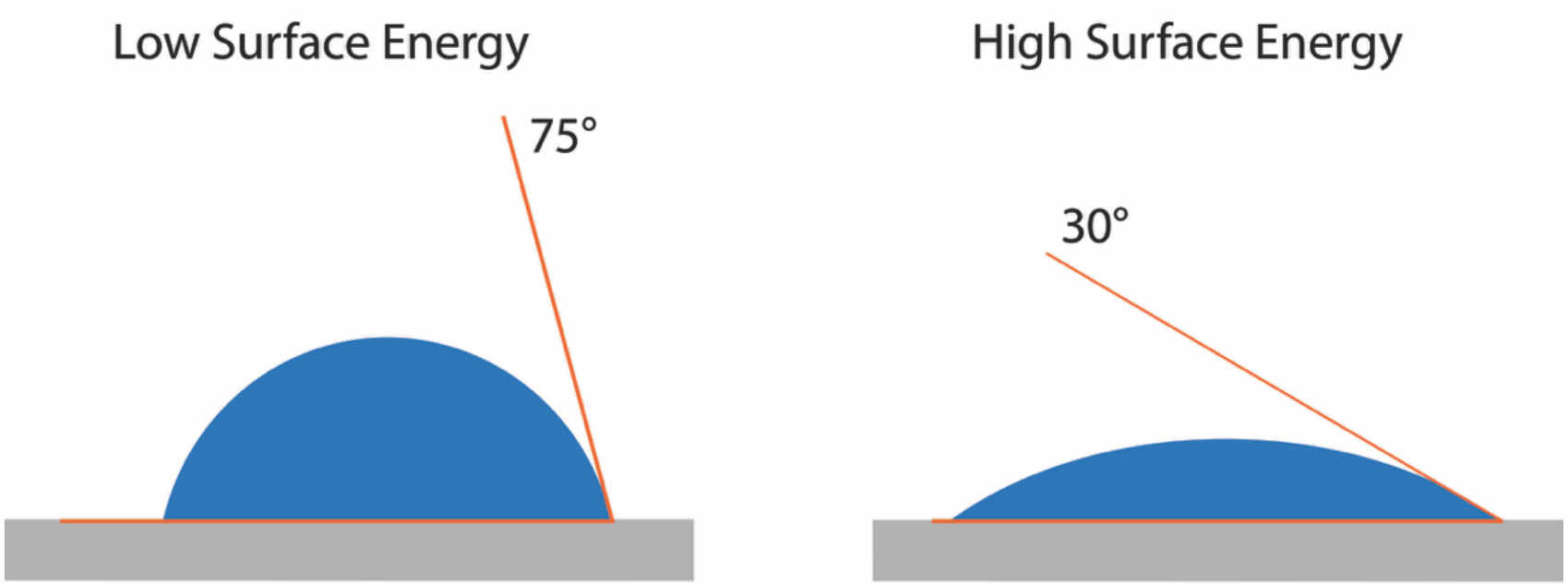


The Question

- What is different in breast cancer ECM from African Americans that leads to increased metastasis?
- Can it be used to improve therapy outcomes?

Hypothesis

Breast cancer ECM from African American patients has different *surface energy* compared to Caucasian patients

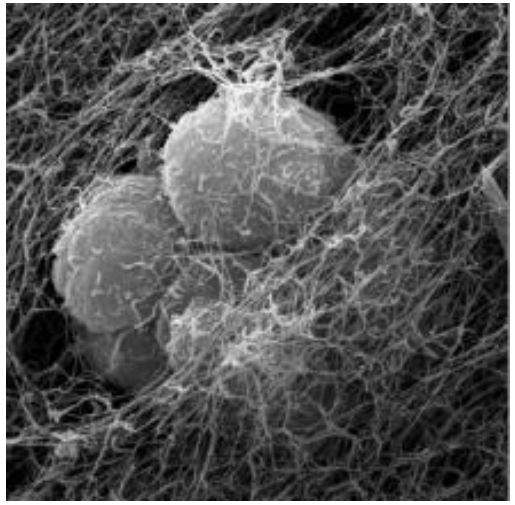


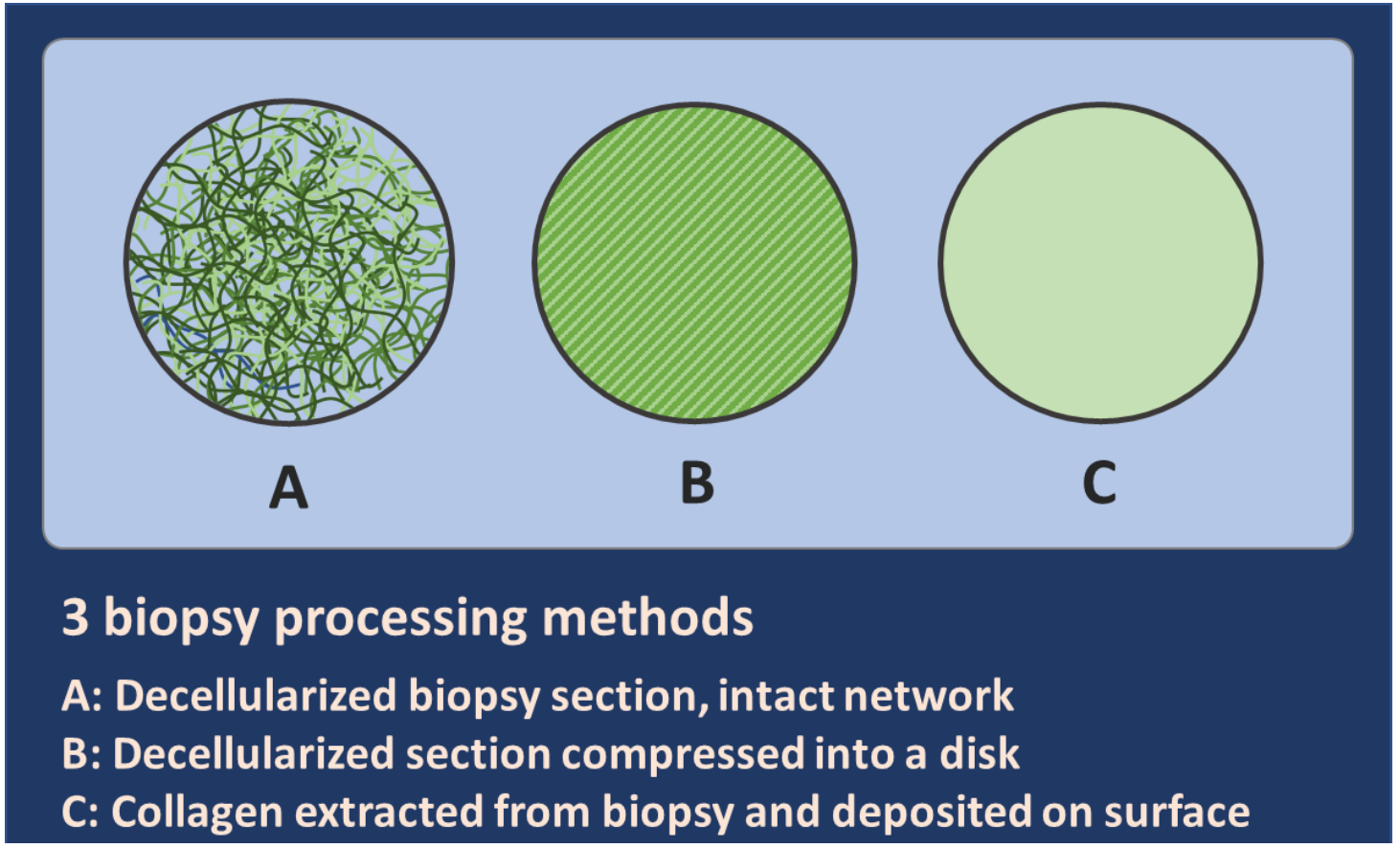
https://www.btglabs.com/blog/materials-science/water-contact-angle

Objective

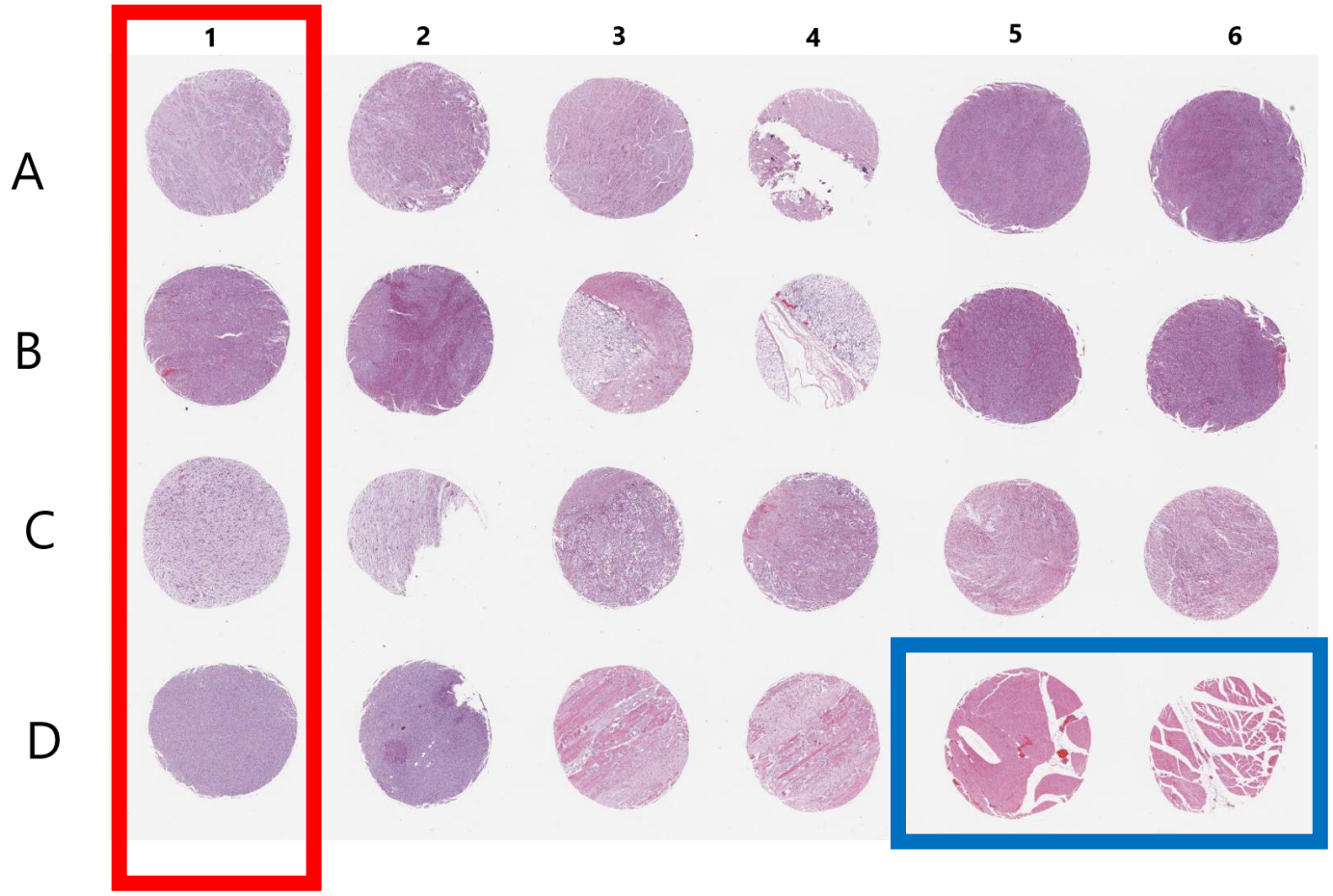
- Develop a method to detect differences in ECM using patient biopsies
- Quantify differences between breast cancer ECM from African American and Caucasian women

Method Development





Method Development

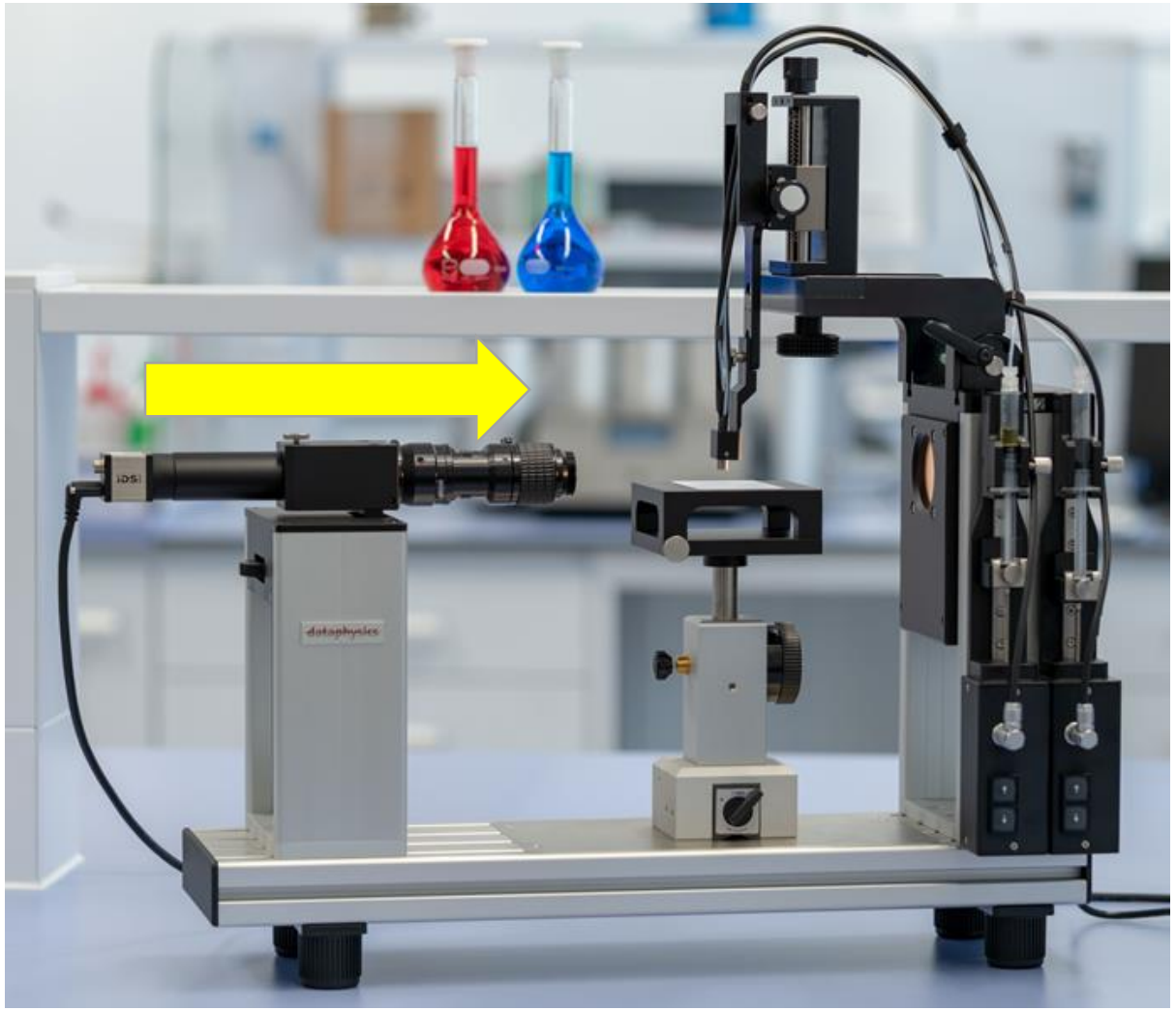


- Cancer biopsy array – multiple types

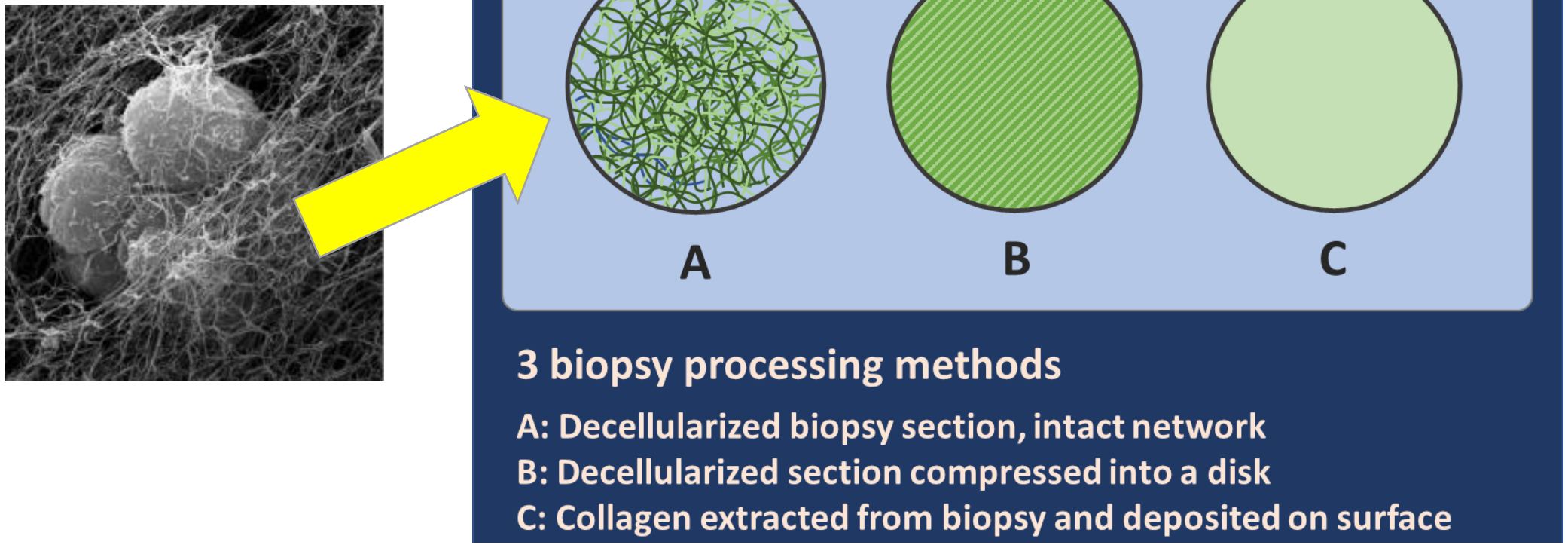
Method Development

DataPhysics

Optical Tensiometer

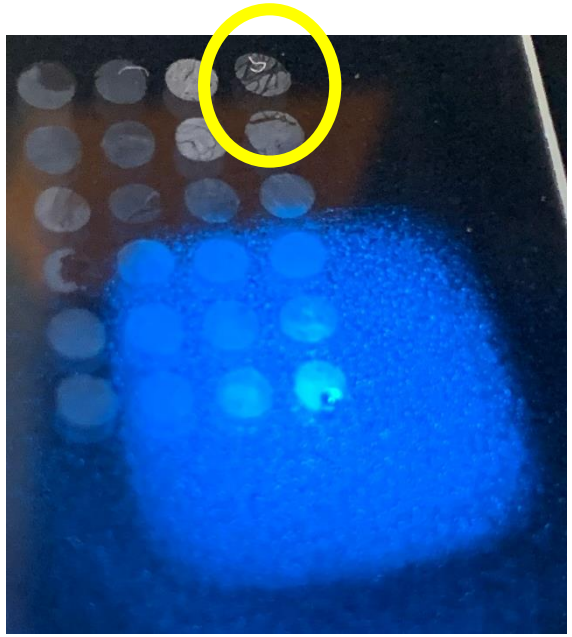


Method Development

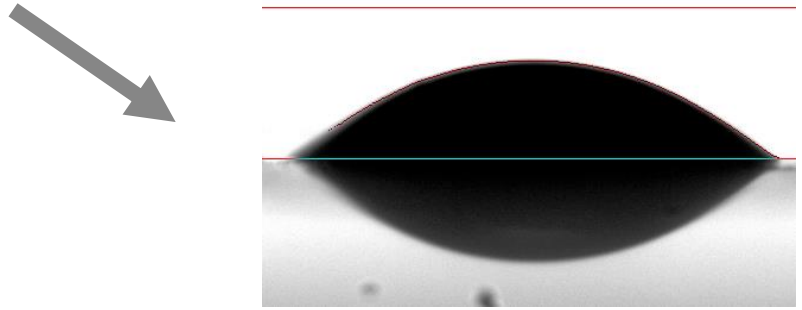


Method Development

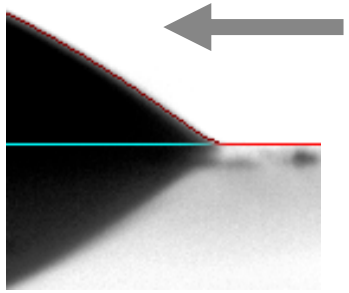
Eye view



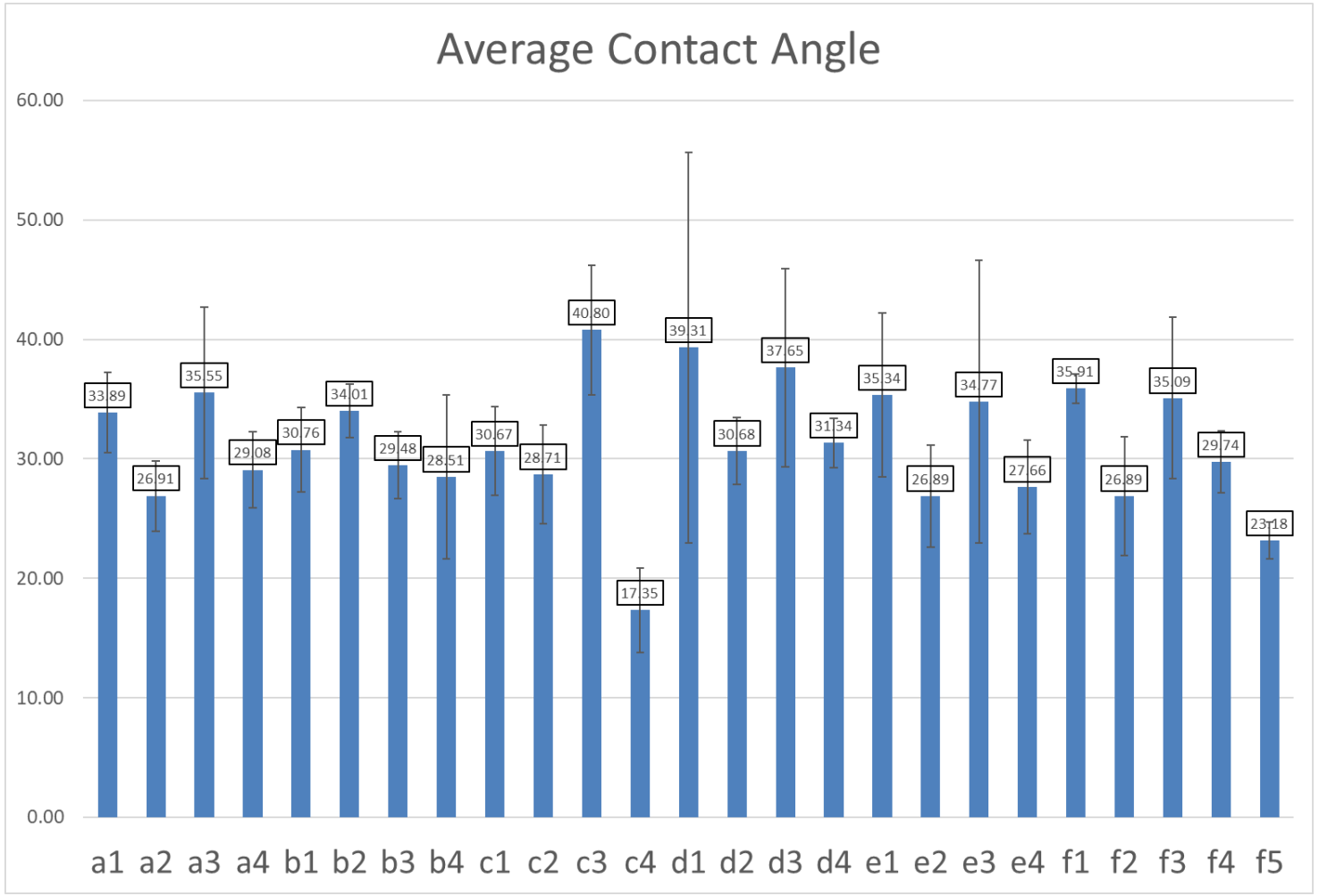
Side view image
(SCA25, *DataPhysics*)



Contour



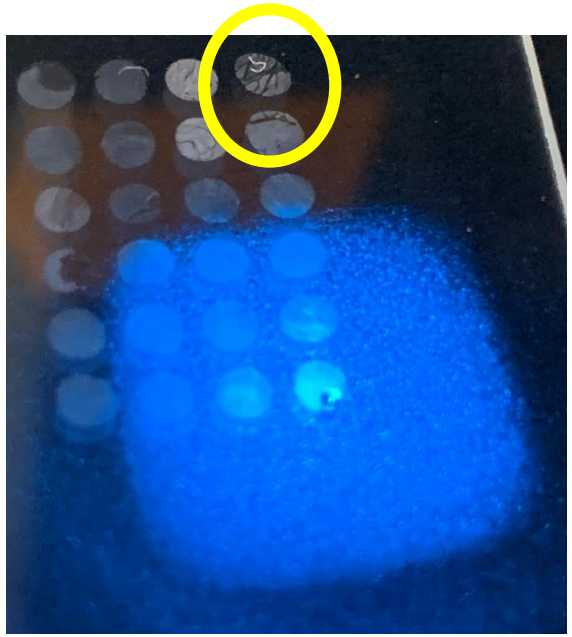
Method Development



Error bars too large!

Method Development

Eye view



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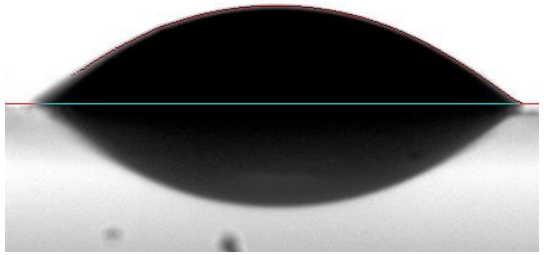

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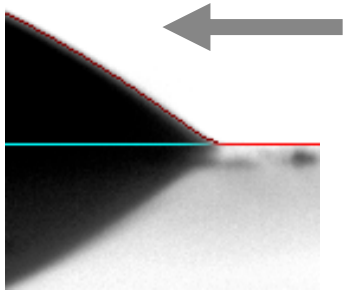


Top view image (TV10, *DataPhysics*)

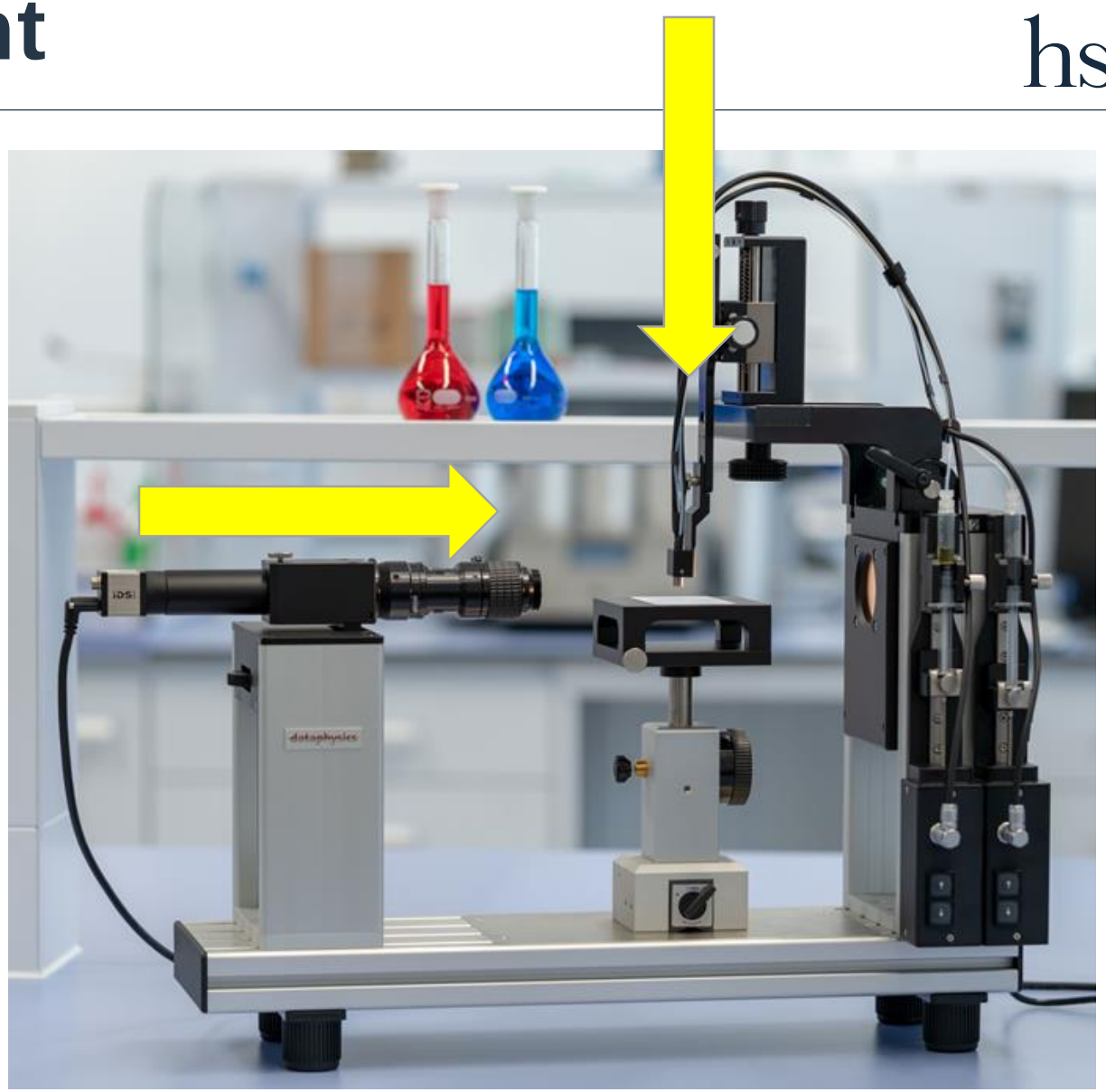
Drop outside section

Method Development

DataPhysics

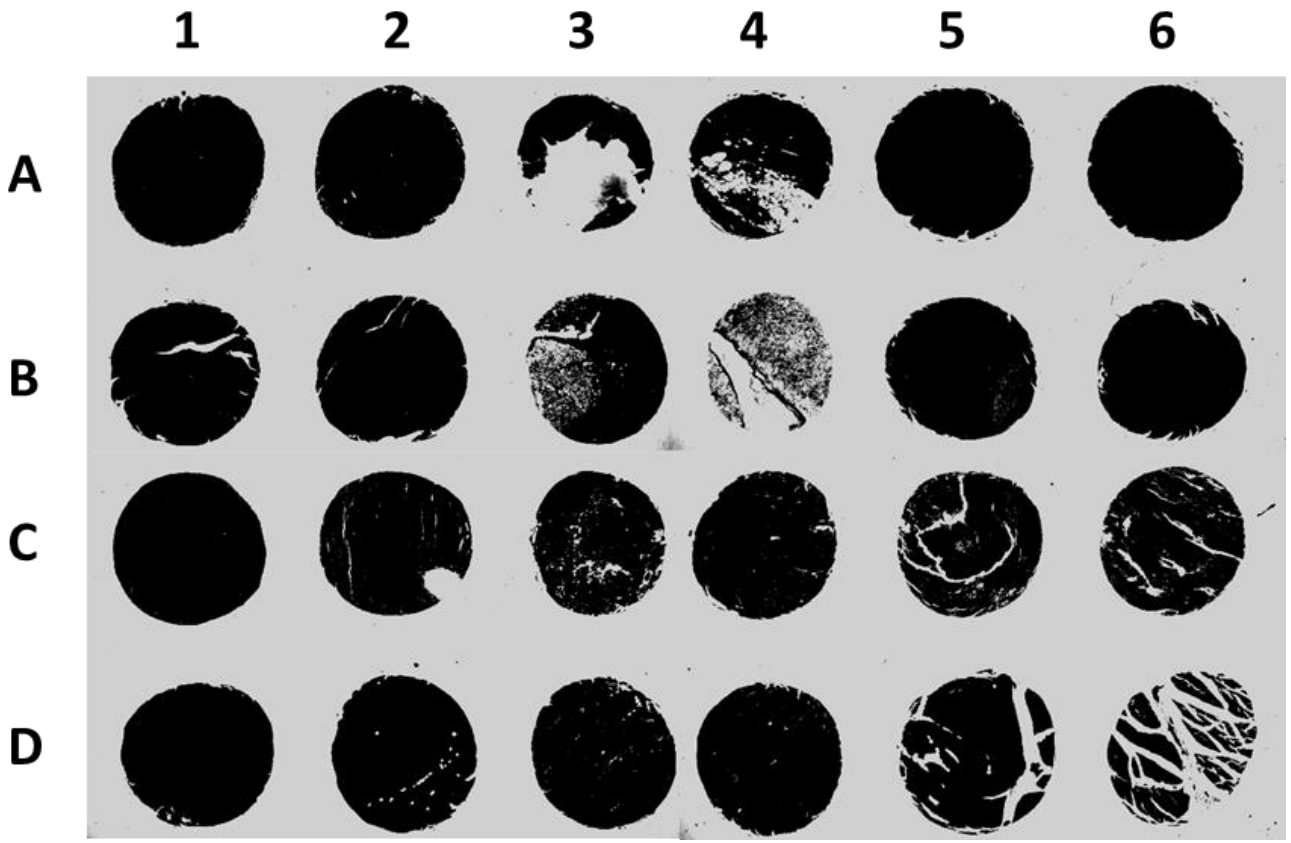
Optical Tensiometer

Side view and top view cameras

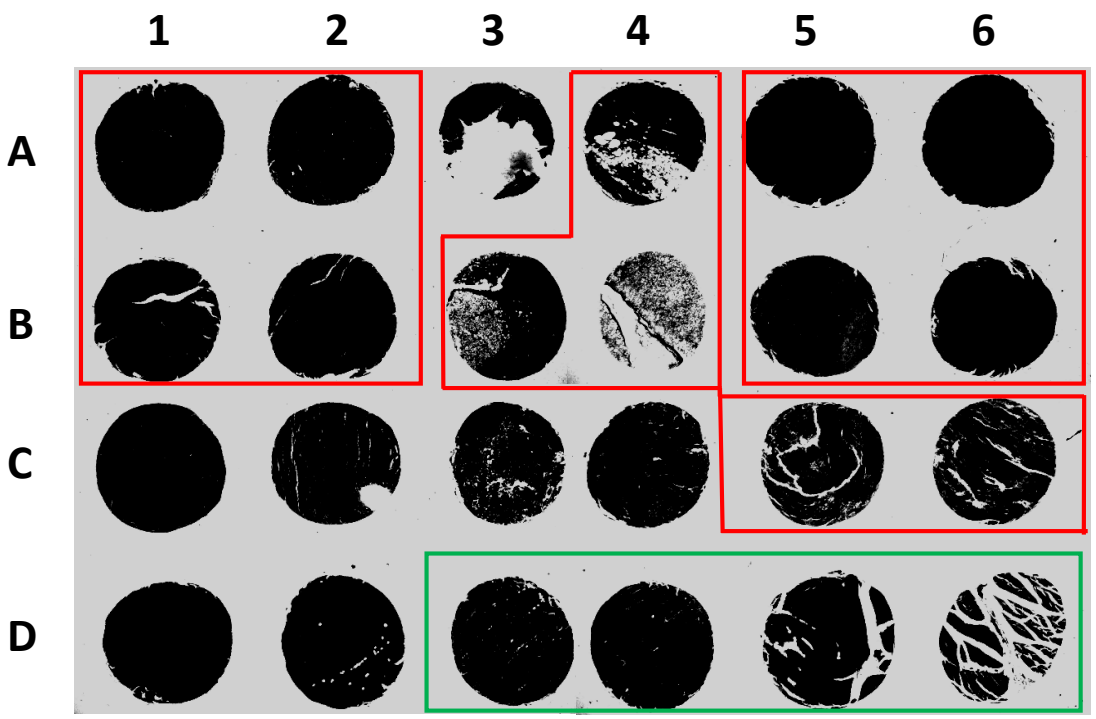


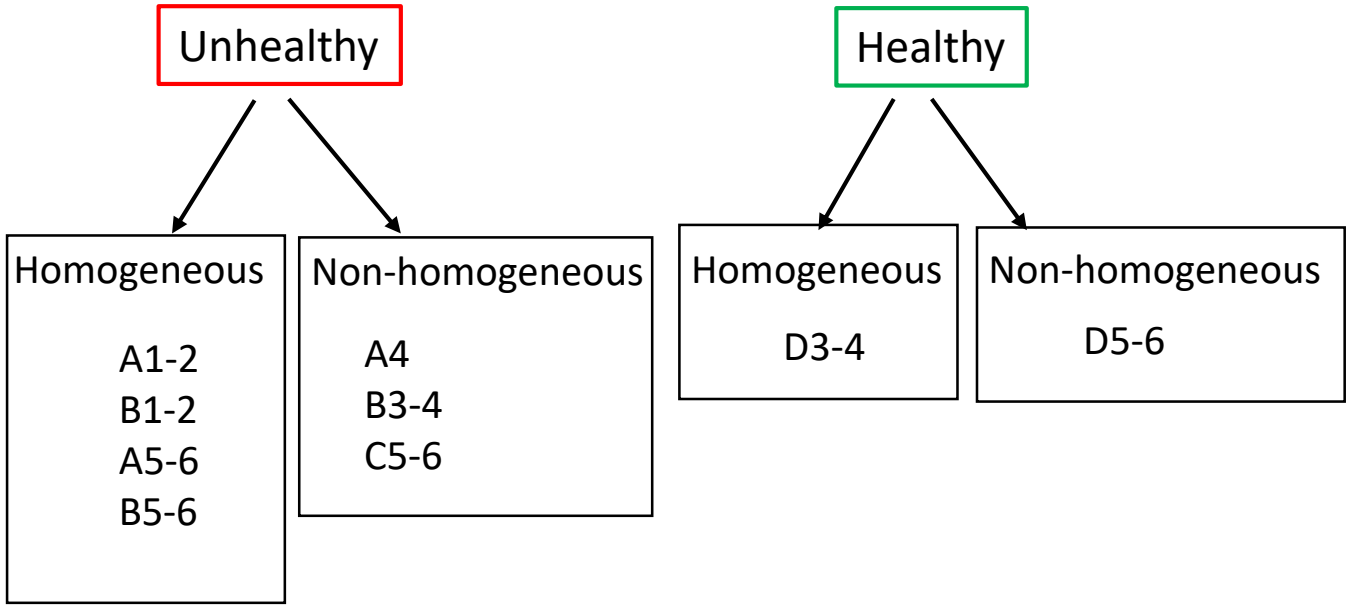
Method Development

Biopsy array from top view camera

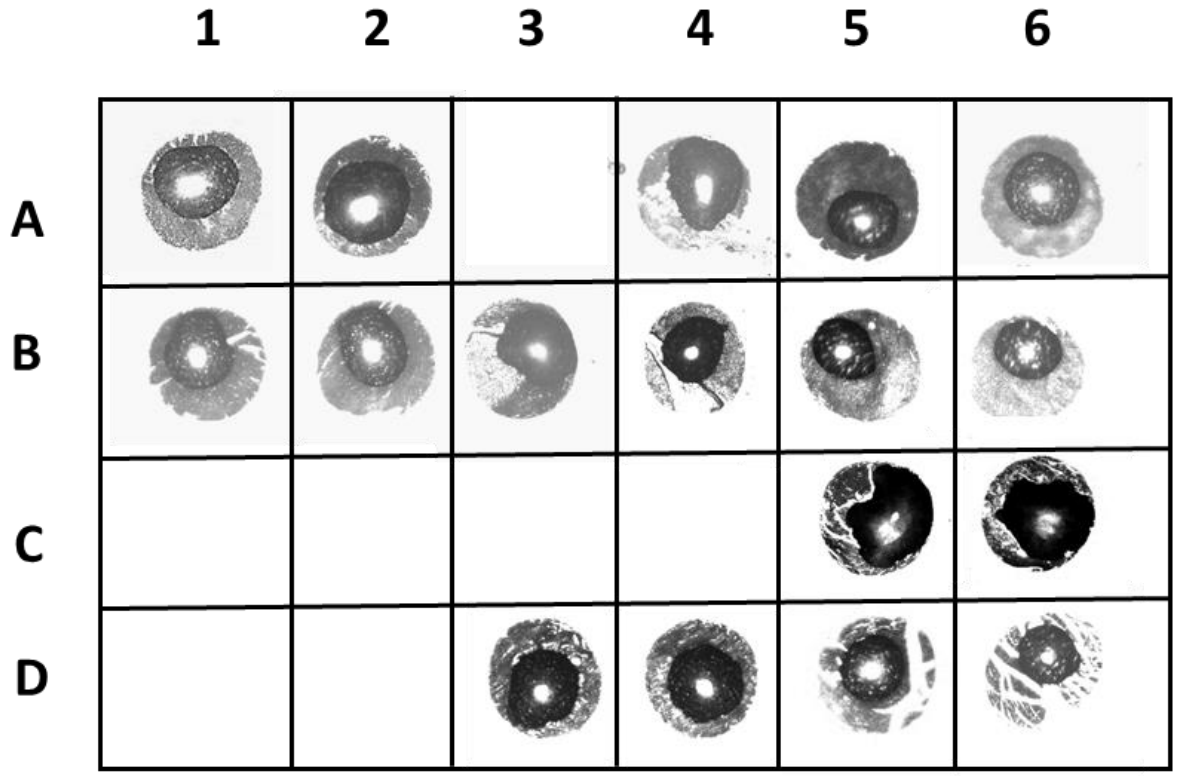


Method Development





Method Development



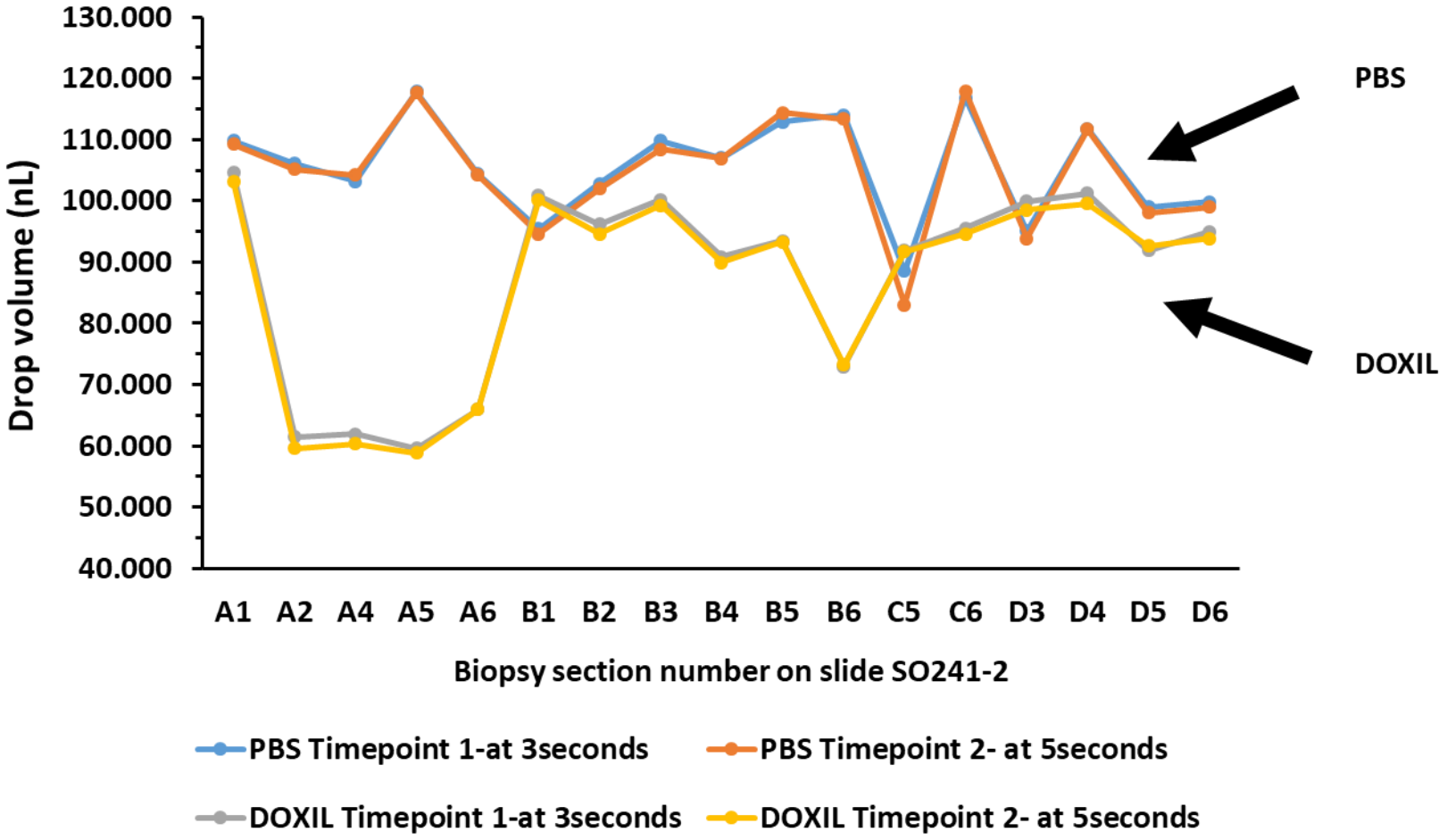
PBS drops top view using TV10, *DataPhysics*

Accurate droplet location on each biopsy

Method Development

- ✓ Biopsy processing
- ✓ Droplet generation & accurate placing
- ❑ Droplet volume control
  - Nanoliter drops prone to rapid evaporation

Method Development



Method Development

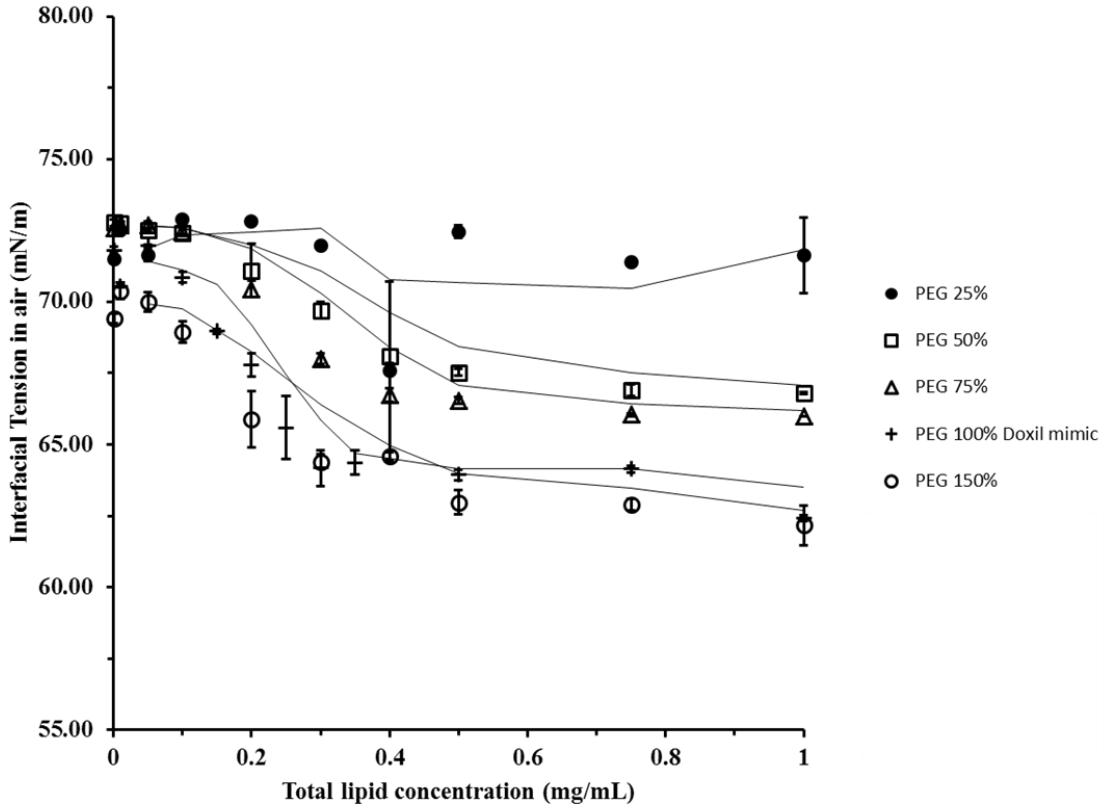
- ✓ Biopsy processing
- ✓ Droplet generation & accurate placing
- ❑ Droplet volume control
  - Nanoliter drops prone to rapid evaporation
- ❑ Apply to biopsies with demographic data

Pairing the right treatment with patients

- Breast cancer ECM as well as nanotherapeis like Doxil® show variability in surface energy
- *Two moving targets*
- Need to characterize both patient tumor and nanotherapy

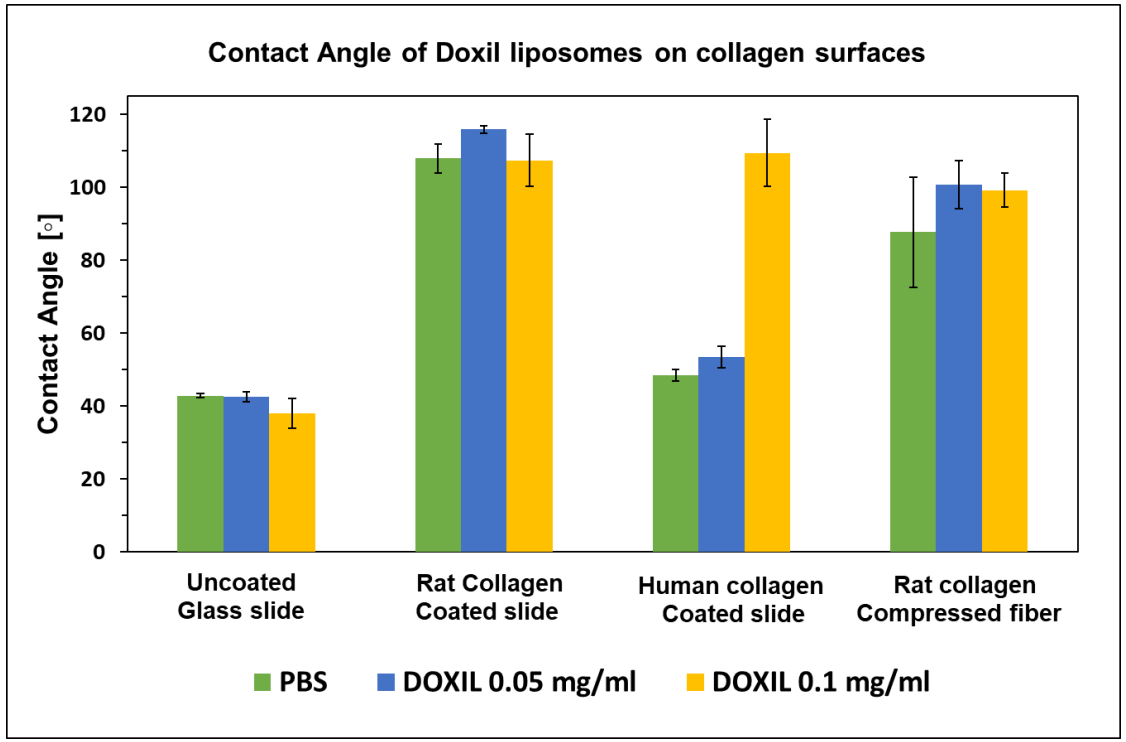
Surface tension of Doxil®

Doxil® - one of the most popular nanotherapies used in breast cancer



Some dose-response relationship between PEG content and surface tension

Pairing the right treatment with patients



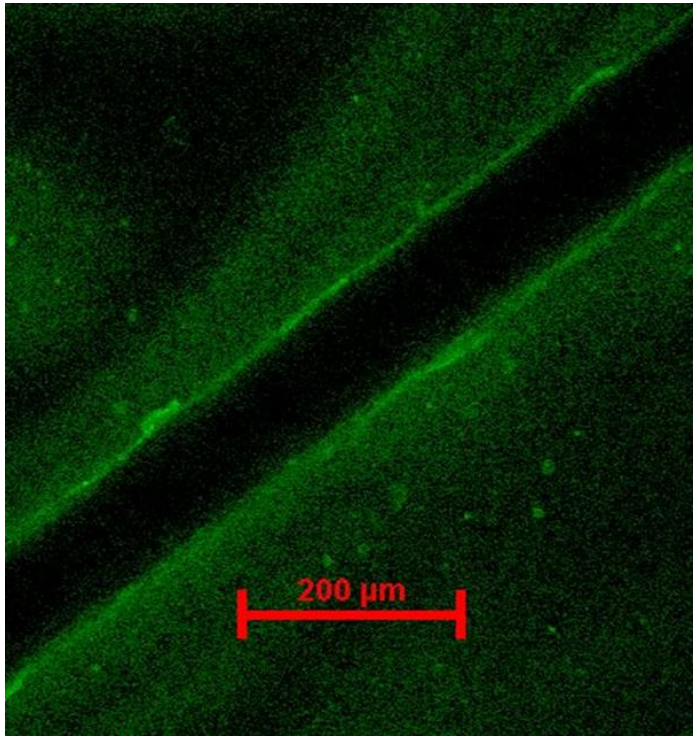


Fig. 1. Left: Contact angle measurements of rat/human collagen deposited on glass slides and rat collagen fibers compressed into a continuous disk. Right: Visualization of doxorubucin liposomes (light green) against mounted collagen fiber (black).

Summary

- Breast cancer extracellular matrix contributes to health disparities in African American women that present BC metastasis
- Both tumor ECM and common nanotherapies exhibit complex surface energy properties
- Measuring the relative surface affinity of anticancer nanoperticles with tumor ECM may be a good marker for pairing the right therapy to patients

Acknowledgments

- Texas Center for Health Disparities
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Texas Conference on Health Disparities

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