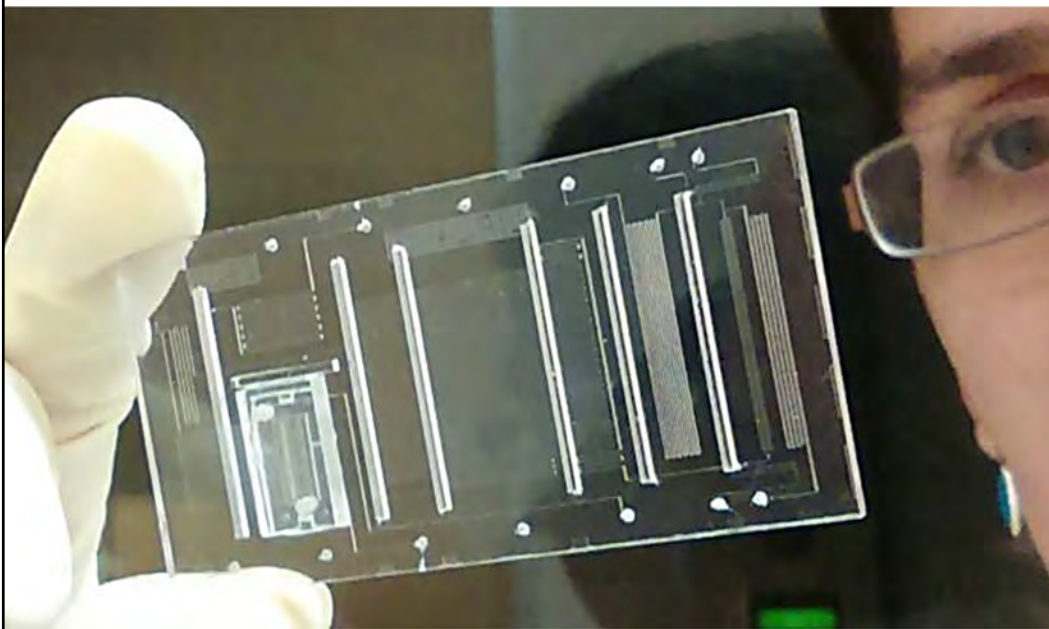




## Center of BioModular Multiscale Systems for Precision Medicine



**Our Mission:** Design, manufacture and deliver new tools to the biomedical community for utilizing liquid biopsy markers for disease detection and management to enable precision medicine.



THE UNIVERSITY  
of NORTH CAROLINA  
at CHAPEL HILL

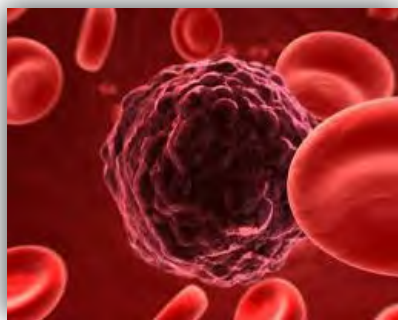


WAKE FOREST  
UNIVERSITY

## What is a BTRC?

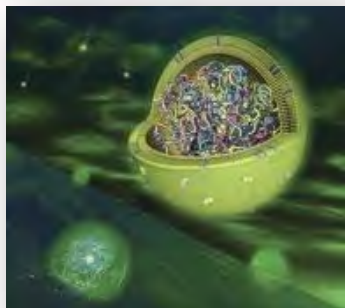
*Biotechnology Resource Centers (BTRCs):*

- ❖ Generate critical and unique technologies and methods at the forefront of their respective fields.
- ❖ Apply technologies to a range of basic, translational and clinical research.
- ❖ Create synergistic interactions between technical and medical experts.



*Scientists at these Centers:*

- ❖ Ensure that NIH-funded biomedical research projects gain access to the newest and most advanced technologies of the Center.
- ❖ Develop methods to improve patient care, and deliver them to the bedside.



CBM<sup>2</sup> is engaged in the Precision Medicine initiative, which seeks to match the molecular makeup of a patient's disease with the appropriate therapy.



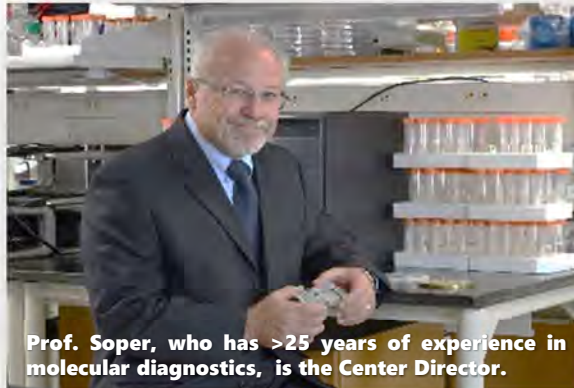
CBM<sup>2</sup> ultimate output is a universal Molecular Processor (uMP) that will secure molecular information from circulating markers.



## Technology Outputs

*Liquid Biopsy markers* can be secured from any biological fluid. These markers come in many forms, such as rare biological cells (CTCs), cell free DNA (cfDNA), and extracellular vesicles (exosomes).

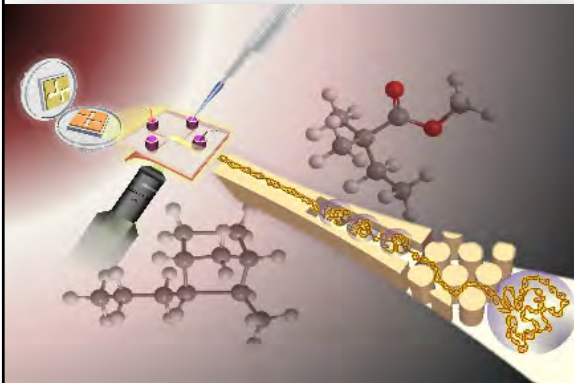
*CBM<sup>2</sup> for Precision Medicine* is developing innovative micro- and nanofabricated tools and the associated assays for the analysis of liquid biopsy markers and the analysis of their cargo.



Prof. Soper, who has >25 years of experience in molecular diagnostics, is the Center Director.

### *Scientific Outputs:*

- ❖ Devices across different length scales (nm → mm) manufactured in high scale production modalities.
  - ❖ CTC isolator
  - ❖ cfDNA extractor
  - ❖ Exosome selector
- ❖ Solid-phase assays to determine marker load.
  - ❖ DNA/RNA sequence variations and copy number changes
- ❖ Label-free detection with high multiplexing capacity.
  - ❖ In-plane nanopores



### **Examples of CBM<sup>2</sup> Translational projects:**

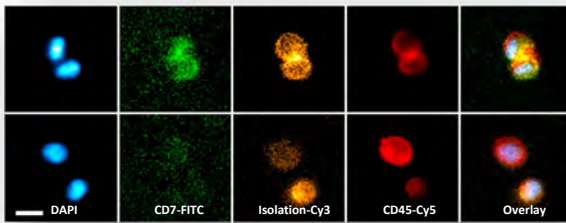
- ❖ Determining minimal residual disease in pediatric patients with acute lymphoblastic leukemia (ALL) with Children's Mercy Hospital.
- ❖ Response to therapy using CTCs for triple negative breast cancer patients with the University of North Carolina School of Medicine.
- ❖ Extracellular vesicles as blood markers for ischemic stroke with Downstate Medical in New York.



# Translational Research & Development (TR&D) Projects

## TR&D 1

- ❖ Innovative platforms and the associated methodologies to select CTCs, cfDNA, and exosomes from clinical samples.
- ❖ Strategies for the surface modification of microfluidic and nanofluidic devices for user-defined applications.



## TR&D 2

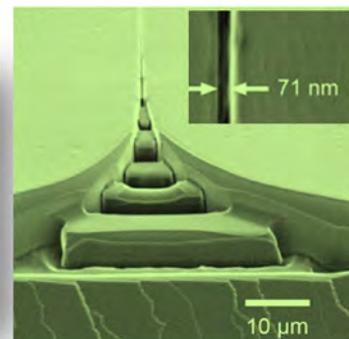
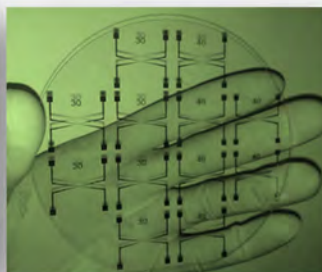
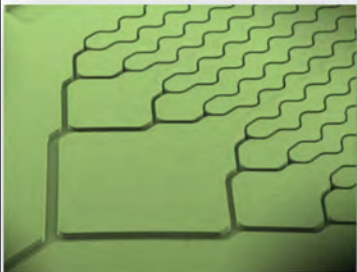
- ❖ A suite of isothermal enzymatic reactions to enable comprehensive and multi-dimensional molecular profiling of DNA and RNA.
- ❖ Creating a new paradigm for blood-based detection termed "circulating marker load."

## TR&D 3

- ❖ Novel fabrication strategies for the production of plastic devices at low-cost and with high compliance using injection molding.
- ❖ Devices that employ single-molecule identification and/or quantification using in-plane nanopores.

## TR&D 4

- ❖ Functional mixed-scale and modular systems that process circulating markers for *in vitro* diagnostics.
- ❖ Commercial partners for transitioning new discoveries into the biomedical community.



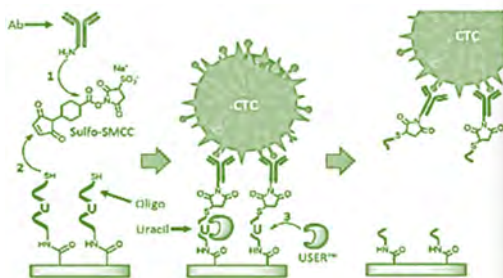
## Collaboration & Service

CBM<sup>2</sup> Collaboration/Service Projects adopt a push-pull format in which:

- ❖ Collaborator's needs guide technology development.
- ❖ Expand the potential applications of CBM<sup>2</sup>'s outputs for a variety of biomedical applications.

### Types of Engagements with the Center

- ❖ **Collaboration Projects** consist of concept exchange between Center and external researchers that may result in joint IP and/or funding opportunities.
- ❖ **Service Projects** assist researchers to achieve their fabrication or clinical study needs. No exchange of IP between scientists occur.



- ❖ We use Collaborative Projects to collect pilot data in compelling applications as a venue to facilitate competitive grant submissions by our Collaborators.
- ❖ Joint projects can be of a fabrication emphasis, which utilize our unique infrastructure and expertise, or clinical, which takes advantage of our device discoveries.
- ❖ We are ready to work with you to satisfy your project needs!

## Molecular Biology Facilities



**Tools** for molecular processing include an Accuri Flow Cytometer, Droplet Digital PCR, HiSeq, MiSeq and MiniSeq Illumina Next Generation Sequencers, fluorescence microscopes for imaging and single-molecule tracking, RT-qPCR, DNA shearing, Agilent Tape Station, and Ultracentrifuge.



**CBM<sup>2</sup> possesses a suite of tools to support your clinical and biological work for evaluating device performance for your application needs.**

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 **CBM2PrecisionMedicine**

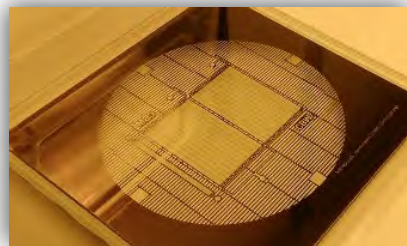
 **CBM2Medicine**



## Micro/Nanofabrication Facilities

### **KU Nanofabrication Facility (KU – [microfab.ku.edu](http://microfab.ku.edu))**

- ❖ 4,000 ft<sup>2</sup> Class 100/1000/10000 cleanroom.
- ❖ Photolithography, plasma, dry etching, wet etching, metal and dielectric material thin film deposition, electron microscopy, ellipsometry, device characterization, laser ablation and engraving, 3D printing, and CNC machining.
- ❖ Nanoimprinting, hot embossing, injection molding, and precision micromilling that can prototype devices with dimensions to 20  $\mu\text{m}$ .



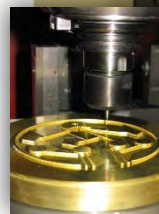
### **CHANL (UNC – [CHANL.unc.edu](http://CHANL.unc.edu))**

- ❖ 2,500 ft<sup>2</sup> Class 100 cleanroom.
- ❖ Suite of microscopy, fabrication, and spectroscopy tools.
- ❖ DRIE, PECVD, metal sputtering, e-beam evaporation, and a Karl SUSS MA6 mask aligner.
- ❖ JenOptik HEX03 hot embosser and a Resonetics laser ablation tool for rapid prototyping.



### **CAMD (LSU – [www.camd.lsu.edu](http://www.camd.lsu.edu))**

- ❖ Photolithography and electroplating.
- ❖ Capability to generate sub-micron structures in photoresists.
- ❖ Thin film deposition of different metals through e-beam or sputter deposition.
- ❖ Metrology including SEM analysis, interferometric capabilities, and scanning tip measurements.
- ❖ Fabrication beamline for X-ray lithography.





## Training, Dissemination & Workshops



### CBM<sup>2</sup> Workshop - How to Make It

- ❖ CBM<sup>2</sup> annual workshop consists of a series of lectures and hands-on experiments in microfluidics for clinical applications.
- ❖ Hands-on experiments consist of participants fabricating a microfluidic device, and its use.
- ❖ Workshops take advantage of the extensive infrastructure and resources available at the Center's affiliated institutions (University of Kansas; University of Kansas Medical Center; UNC-Chapel Hill; Louisiana State University).

**The CBM<sup>2</sup> workshop provides attendees with an understanding of basic principles of microfluidics for compelling biomedical applications along with a hands on lab to build and test a device.**

To find out more, visit our website at

<http://cbmm.ku.edu>

