TEAM 21

Low-cost Microfluidics Chip for Novel Single-Molecule Telomere Profiling System to Detect and Subtype ALT Cancers

Sarah Beyer, Gwyneth Steele, Nihar Talati, Dylan Landes Project Advisor: Ming Xiao | PHD Student: Kaitlin Raseley

School of Biomedical Engineering, Science and Health Systems | Drexel University, Philadelphia PA

Drexel University School of Biomedical Engineering, Science and Health Systems

Need

1.9 million cancer diagnoses annually in the United States[1]

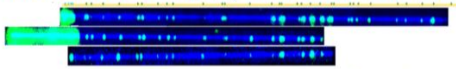
10-20% of these cancers are **A**lternative **L**engthening of **T**elomere cancers (ALT)[10]

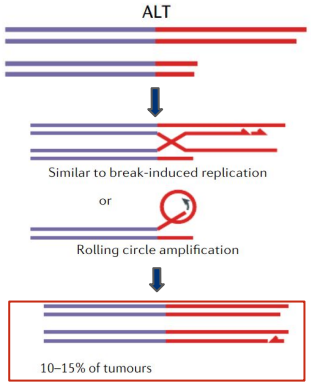
No commercially available methods for accurately diagnosing early stage ALT cancers [1]

Objective: *To design an inexpensive & user-oriented DNA Linearization device for quality and high throughput telomere length analysis compatible with Dr. Xiao's current system*

The Single-Molecule Telomere Profiling Software:

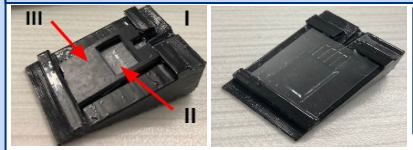
Calculates Telomere length by fluorescent label intensities:





Solution

Design inputs → Telomere length: **±500bp**, Assay Duration: **< 48 hours**, Minimum input concentration: **0.5ng/uL**, Sample DNA range from **2-50kbp**



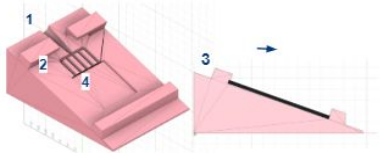
Design Controls		
	1. Inlet notch & Incline - *Loading DNA & Direct flow from inlet to channels*	**3. Separation Distance** - *Control flow rate by capillary pressure*
	2. Microchannels - *Achieve directional flow*	**4. Outlet Well** - *Collect non-linearized DNA & enable continuous flow; potential for multiple samples*

Components:

I. 3D printed (FFF) Microfluidic platform
Function: Control the extent of DNA elongation

II. Positively charged coverslip
Function: +/-/+ layer scheme polymer coating for DNA Fixation

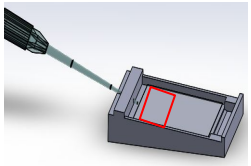
III. 3D printed (SLA) top cover
Function: Secure coverslip to base

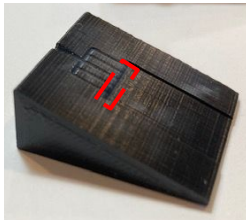


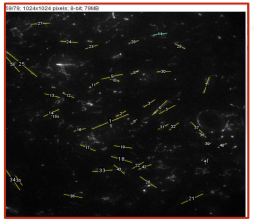
Testing Results

Verification Test I: Analysis of Linearization

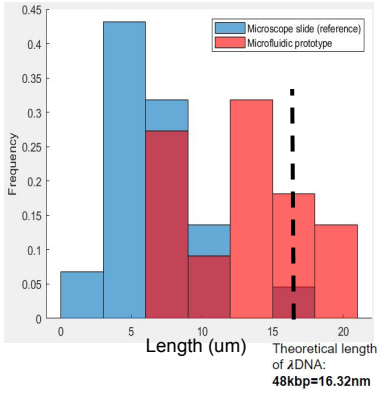
Objective: To evaluate linearization and uniformity required for precise and accurate Telomere length measurements.







Conversion: 1 pixel=100nm



Theoretical length of λDNA: **48kbp=16.32nm**

RESULTS: *PASS*

- ★ ***Linearization extent of >80% on average***
- ★ ***Potential to load higher concentration of DNA***

Future Work

- ★ *Utilize **PDMS 3D Printing Material** due to additives in SLA material*
- ★ *More **efficient** and **time effective** coverslip preparation*

Impact

- ★ ***Drives*** innovation in cancer research
- ★ ***Allocates*** resources effectively → reduces burden on healthcare
- ★ ***Reduces*** diagnostic costs → increases lab efficiency