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Microfluidic Capture and Quantification of HIV

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Introduction

Human Immunodeficiency Virus (HIV) presents a prominent global health issue, having claimed the lives of 39 million people and currently affecting 35 million people worldwide.¹ Standard techniques for the detection of HIV consist of two facets (viral amplification and immunodetection) that present their own unique advantages. As of 2013, "routine viral load monitoring is now strongly recommended as the monitoring strategy of choice" in managing antiretroviral therapy.² Microfluidic technology offers the ability to analyze small sample volumes, encouraging the development of point-of-care systems for viral diagnostics. The small size of virions limits the use of traditional flat-bed immunoaffinity microfluidic devices. Thus, we validate the effectiveness of a nanoporous filtration matrix to isolate pseudo HIV virions from a solution.³ Following isolation, the captured virions are quantified using a method of cyclic voltammetry adapted from de la Escosura-Muñiz and Merkoçi.⁴ This system, once optimized, has the potential to perform viral load quantification in a point-of-care setting.

Methods

STEPS:

1. Assemble devices (Figs. 1 & 2)
2. Binding assay (Fig. 3)
3. Cyclic voltammetry
4. Generation of standard curve

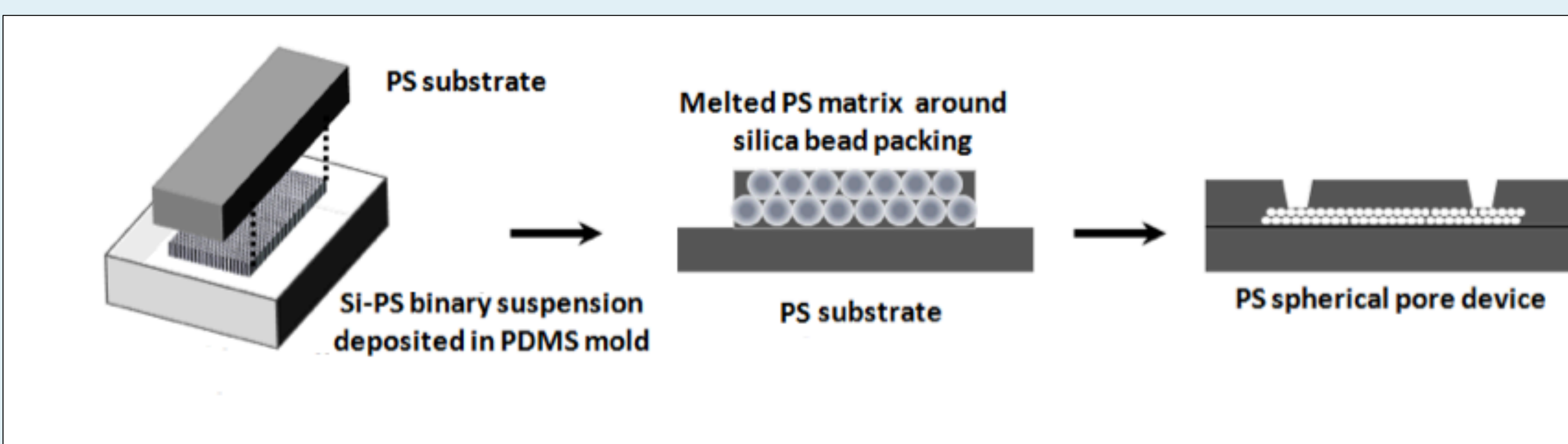


Figure 1: Fabrication process for microfluidic devices.

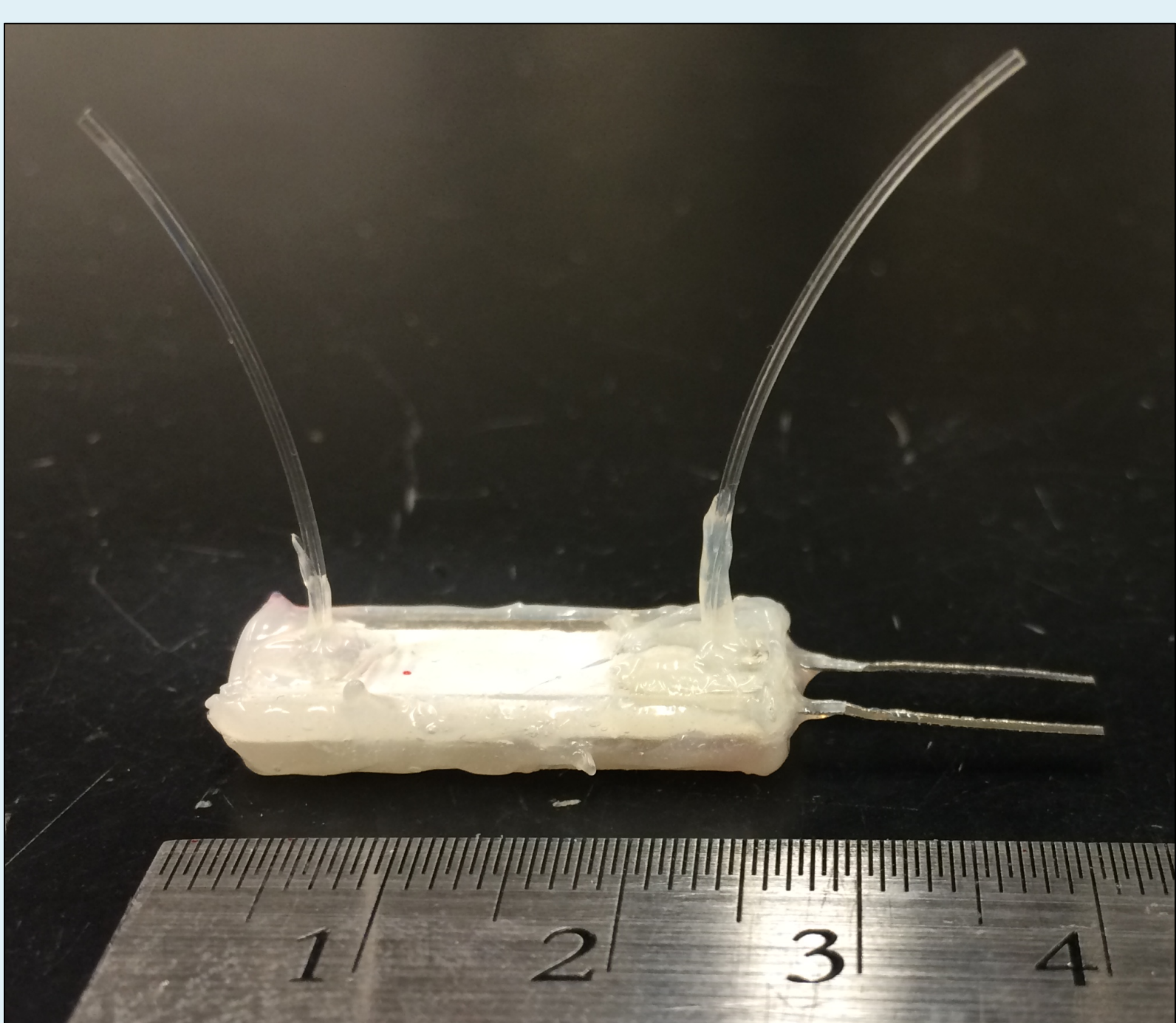


Figure 2: Photo of assembled microfluidic device. Scale is in centimeters.

Cyclic Voltammetry

- Redox solution injected into microfluidic devices
- Voltage swept cyclically from -0.4 to +0.3 V
- Peak current measured

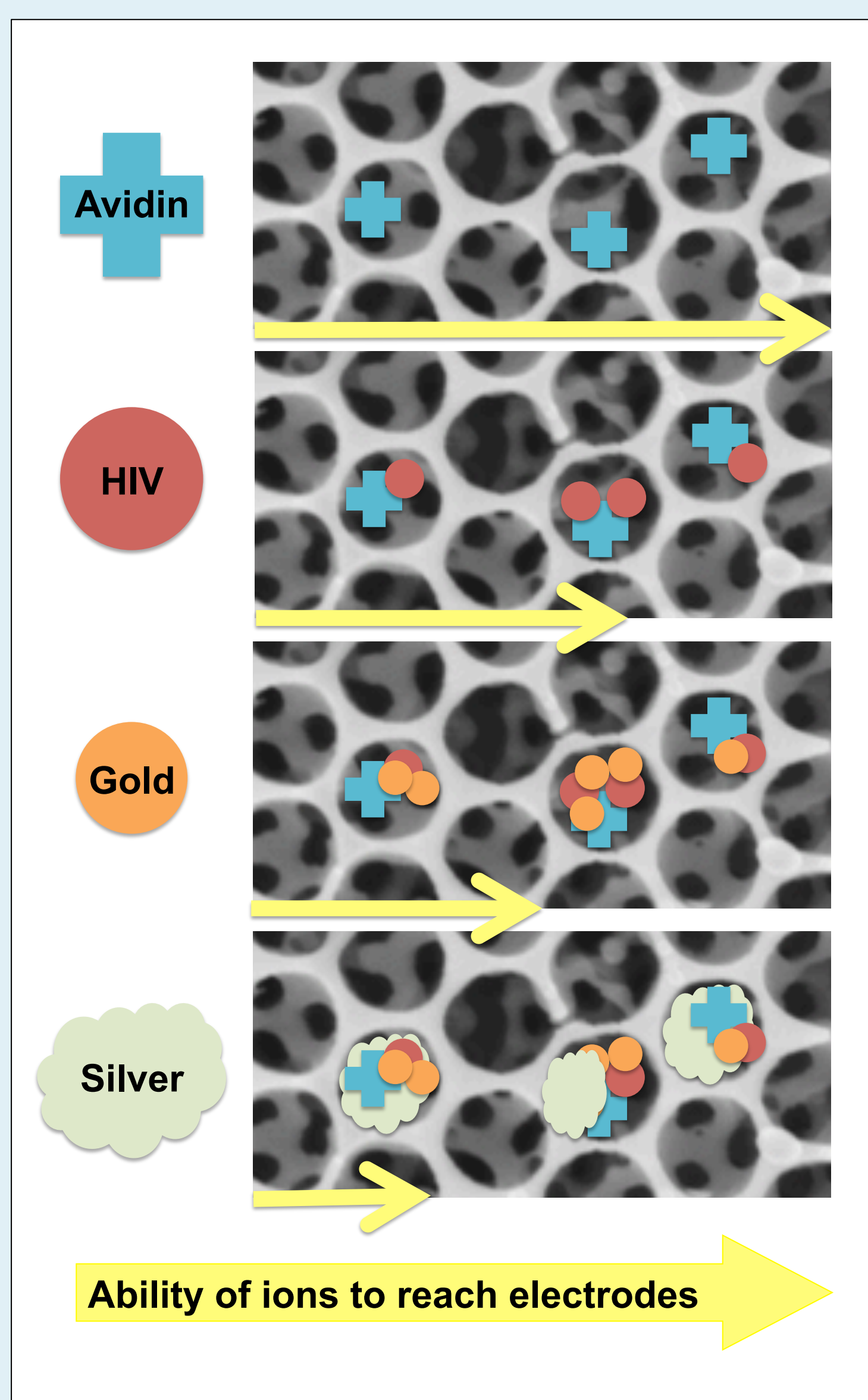


Figure 3: Representation of binding assay run within assembled devices.

Results and Discussion

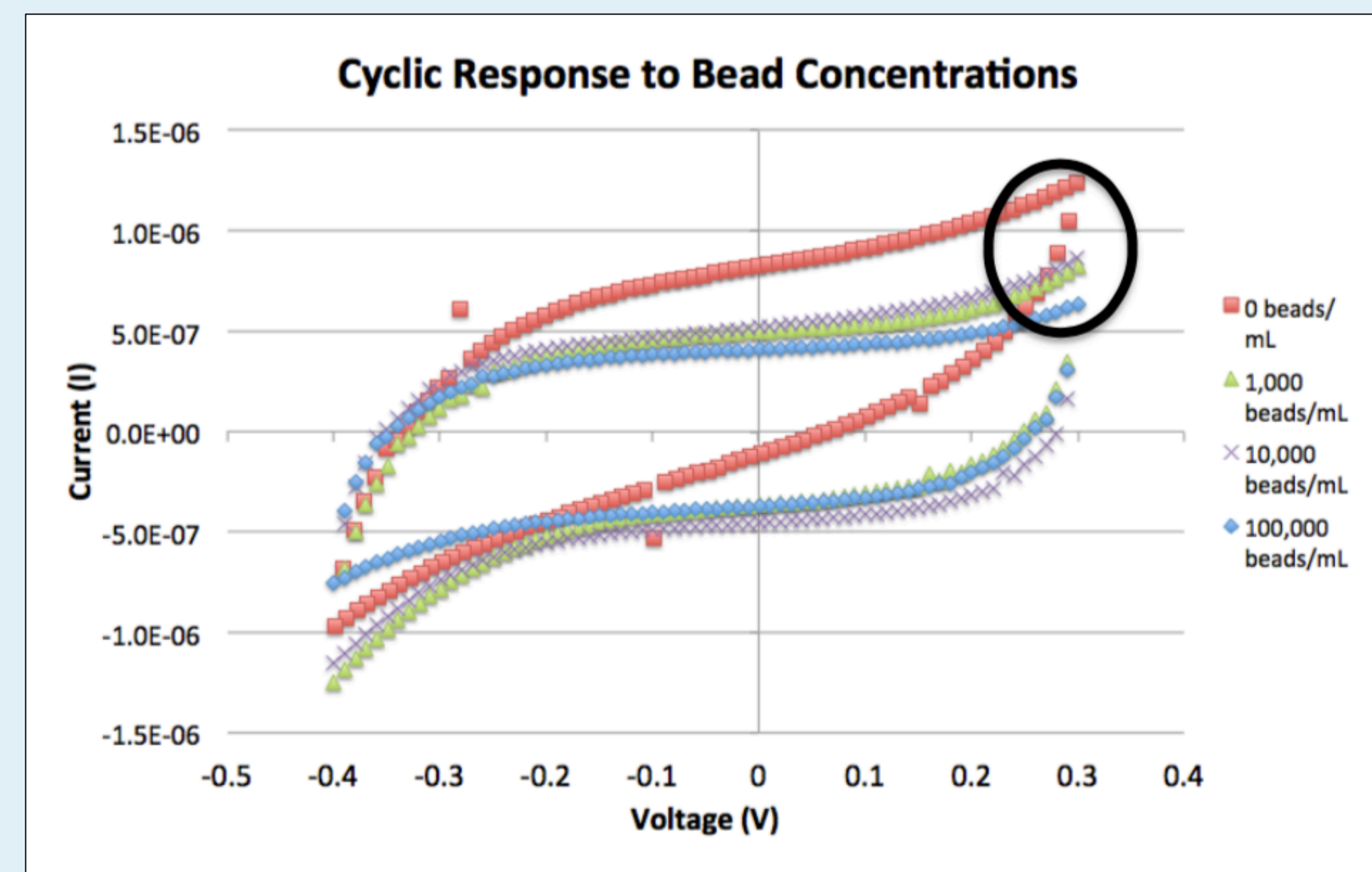


Figure 4: The cyclic voltammetric curves corresponding to four different viral concentrations are shown. Differences in peak currents are highlighted within the black oval.

Figure 5: Peak currents for the proof of concept experiment are shown (n=4). Linear regression indicates an inverse correlation between peak currents and simulated viral load as expected.

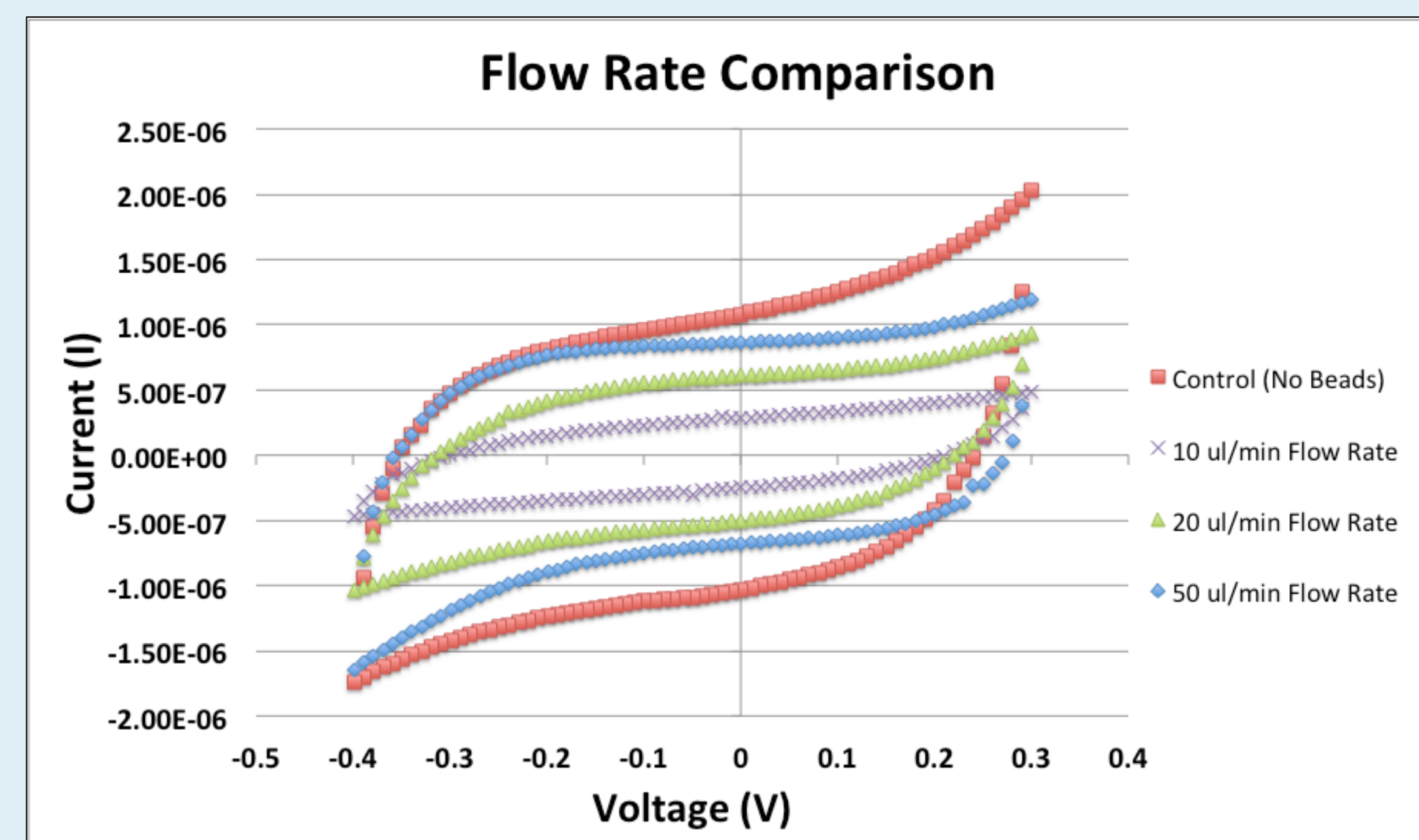
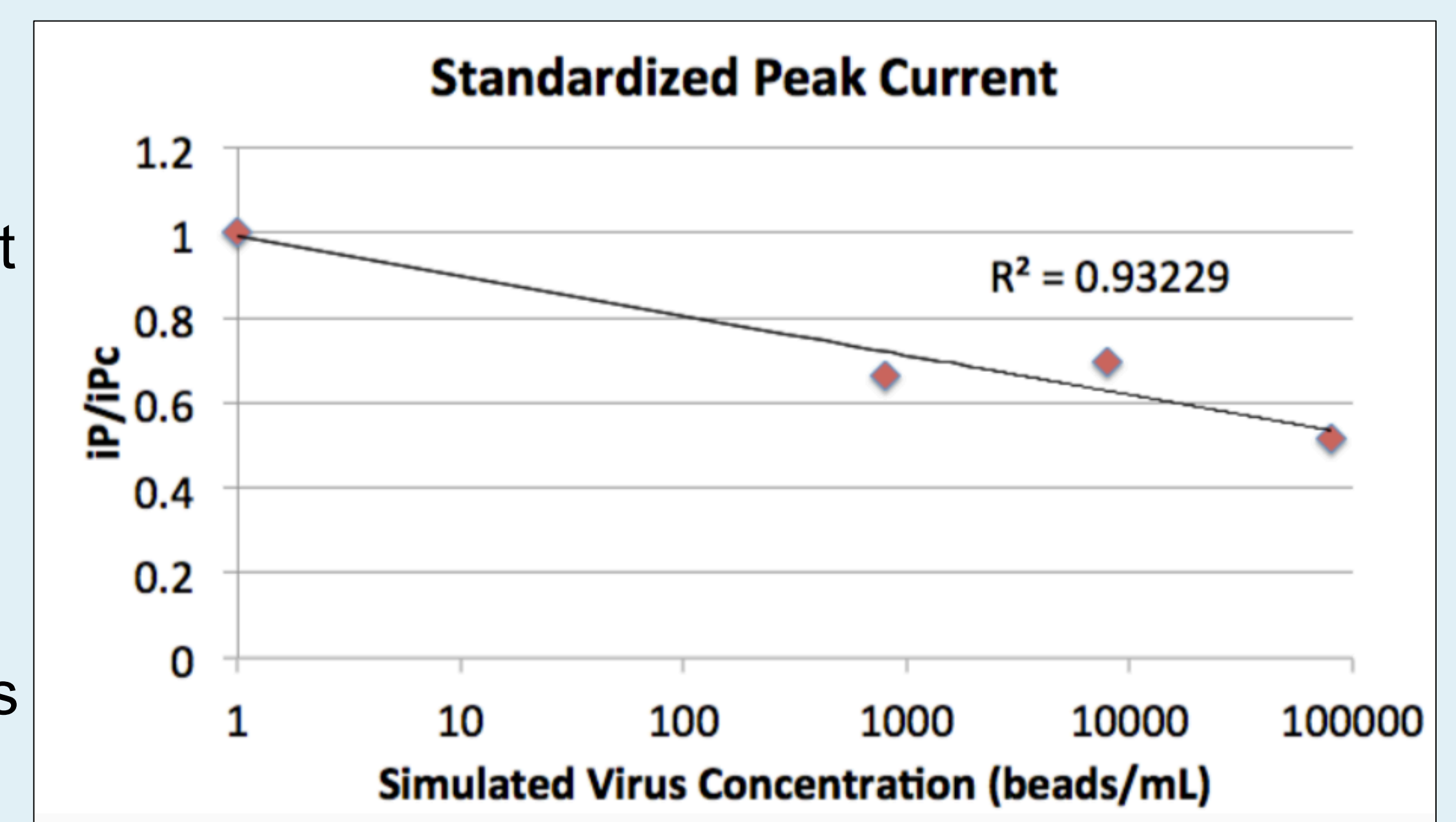


Figure 6: Flow rate optimization test. Higher flow rates correlated with smaller peak current reductions, indicating a decrease in membrane capture efficiency.

Conclusions

- Initial tests indicate ability to quantify viral load through cyclic voltammetry
- Next Steps:
 - Binding assay optimization
 - Generation of standard curve using pseudo-virus

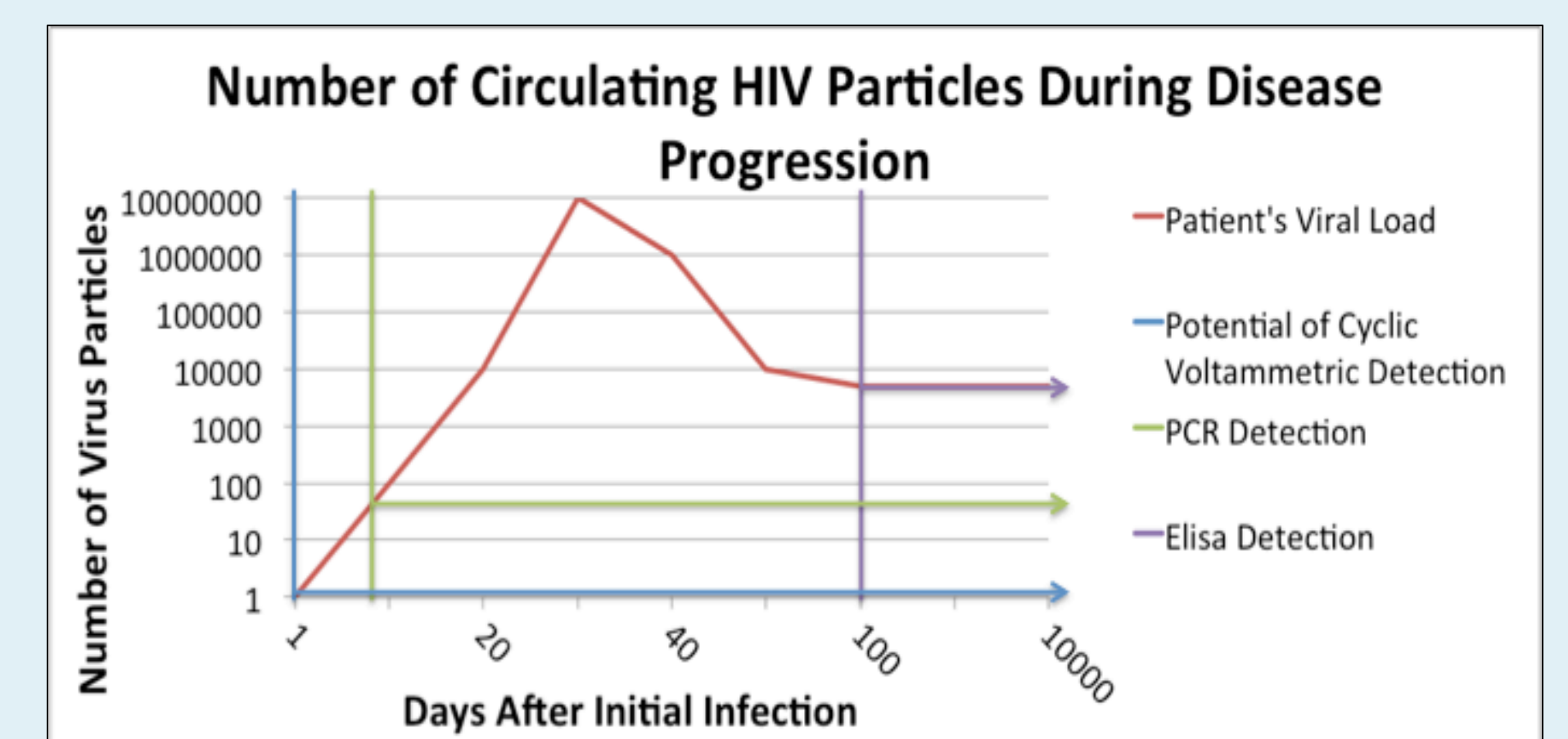


Figure 7: Potential clinical impact of a point-of-care viral load diagnostic test.

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References

1. UNAIDS: "2014 Global Fact Sheet." July 16, 2014. Available www.unaids.org/en/resources/campaigns/2014/2014gapreport/factsheet.
2. World Health Organization: "Technical and Operational Considerations for Implementing HIV Viral Load Testing." July 2014.
3. Surawathanawises, Krissada. "Polymeric Nanoporous Structures Integrated into Microfluidic Device for HIV Detection," PhD Dissertation, Lehigh University, Bethlehem, PA, 2014.
4. de la Escosura-Muñiz, A.; Merkoçi, A. "A Nanochannel/Nanoparticle-Based Filtering and Sensing Platform for Direct Detection of a Cancer Biomarker in Blood," Small, 2011.

