

Single-molecule characterization of blood coagulation, tissue repair and viral invasion

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Biosketch of X. Frank Zhang

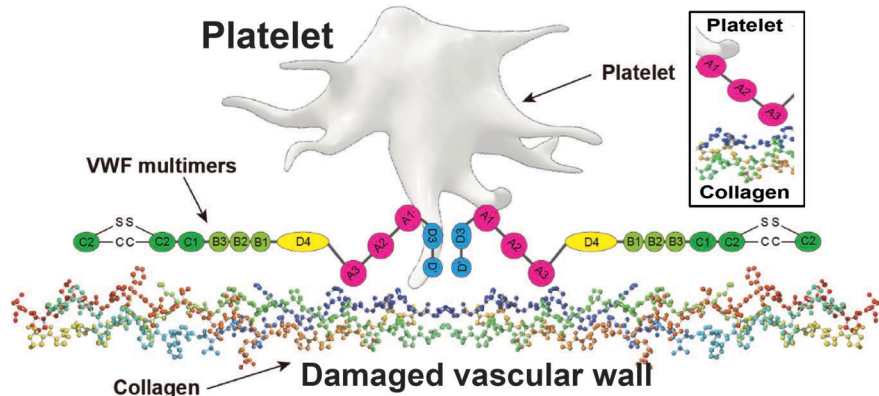


- **BS in Physics and Biology (Sun Yat-sen University)**
 - **MS in Biophysics (University of Hong Kong)**
 - **PhD in Physiology and Biophysics (University of Miami School of Medicine)**
 - **Postdoc in Biophysics, Pathology and Immunology (Harvard Medical School)**
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 2. Zhang, W., Deng, W., Zhou, L., Xu, Y., Yang, W., Liang, X., Wang, Y., Kulman, J.D., **Zhang, X.*** & Li, R.* (2015): Identification of a juxtamembrane mechano-sensitive domain in the platelet mechanosensor glycoprotein Ib-IX complex. **Blood**, 125:562-9.
 3. Dragovich, M.A., Fortoul, N., Jagota, A., Schutt, K., Xu, Y., Sanabria, M., Moller-Tank, S., Maury, W., and **Zhang, X.*** (2019): Biomechanical characterization of TIM protein-mediated Ebola virus-host cell adhesion. **Nature Scientific Reports**, 9(1), 267. [PMID: 30670766]

Research keywords: Molecular biophysics, tissue repair, force spectroscopy, mechanobiology of diseases, viral adhesion, viral entry, Ebola, coronavirus, SARS-CoV-2, antiviral, COVID-19

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Research area 1: von Willebrand Factor (VWF) mechanobiology

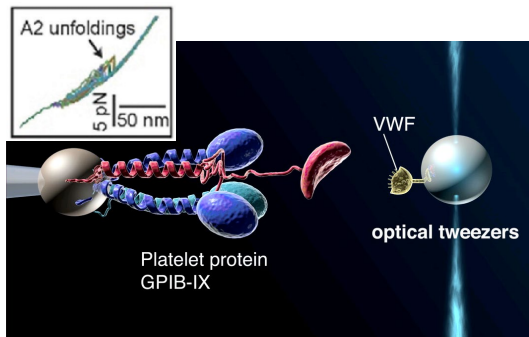


- The large multimeric plasma protein VWF plays an essential role in capturing platelets onto the damaged vascular wall, allowing the initiation of blood clotting.
- Mutations on VWF cause von Willebrand disease, affecting 1-2% of human population.

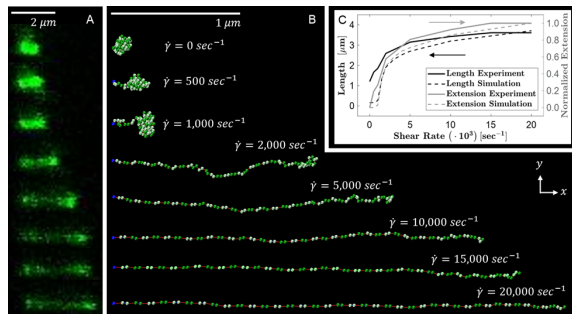
Key questions:

- How does VWF sense blood force and convert it into biochemical signals?
- How to utilize VWF's mechanical properties to treat or preempt bleeding and thrombotic disorders?

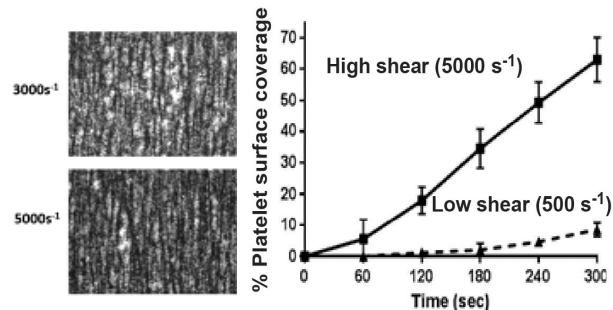
A multidisciplinary approach to address the problem



Single-molecule optical tweezer assay

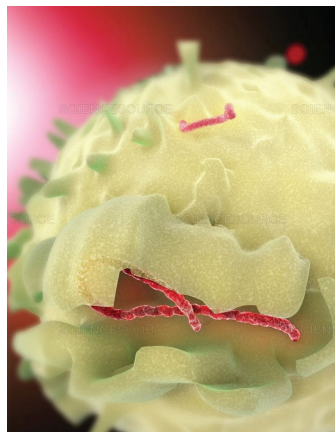


Single-molecule flow assay and coarse-grained simulation

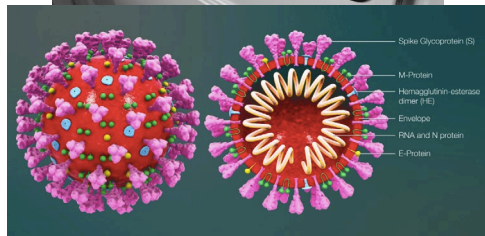


In vitro platelet adhesion and activation assays

Research area 2: Viral Adhesion and Invasion



Ebola virus



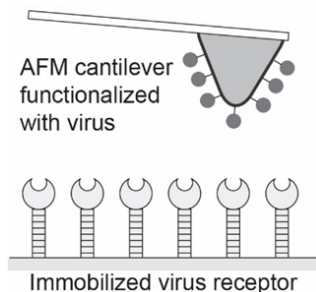
SARS-CoV-2

- Enveloped viruses enter human cells by attaching to cell surface receptors, followed by either direct viral-host membrane fusion or endo-/macropino-cytosis.
- Ebola virus has killed over 12,000 people in Africa.
- SARS-CoV-2 has caused a global pandemic, infected over 37M people and caused over 1M deaths.

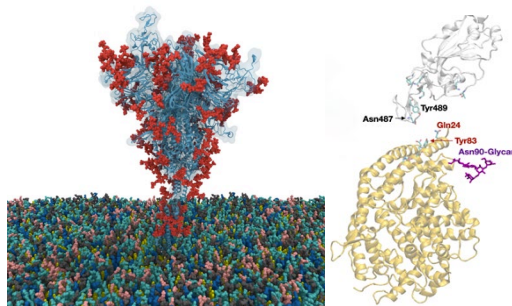
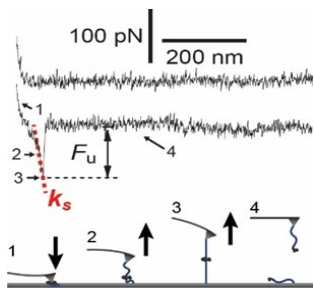
Key questions:

- How does adhesion trigger fusion or internalization?
- How does spike protein utilize multiple receptors?
- How to effectively block viral adhesion and uptake?

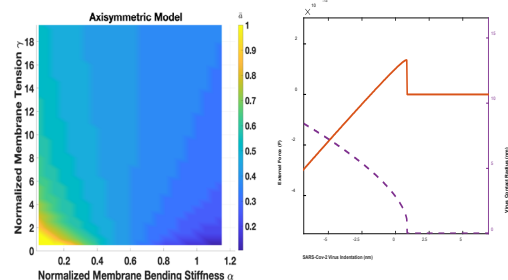
A multidisciplinary approach to address the problem



Single-virus force spectroscopy



All-atom MD simulation



Continuum mechanical modeling
(with A. Jagota, Lehigh University)