MEASUREMENT OF RED BLOOD CELL INTERACTIONS WITH OPTICAL TWEEZERS

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Optical tweezers are a powerful tool to measure forces at the pico-newton (*pN*) level. Optical tweezers, formed by tightly focused laser beams, enable precise control and manipulation of objects at cell level scale. After calibration, quantitative force measurement is possible and enables detailed investigation of cell-to-cell interactions.

We show red blood cell (RBC) aggregation/disaggregation measurement results based on different measurement protocols [1,2]. Double channel tweezers are used to bring the cells in contact for a fixed time period to initialize the aggregation process (Figure 1). Thereafter, one of the traps is moved step by step to disaggregate the cells.

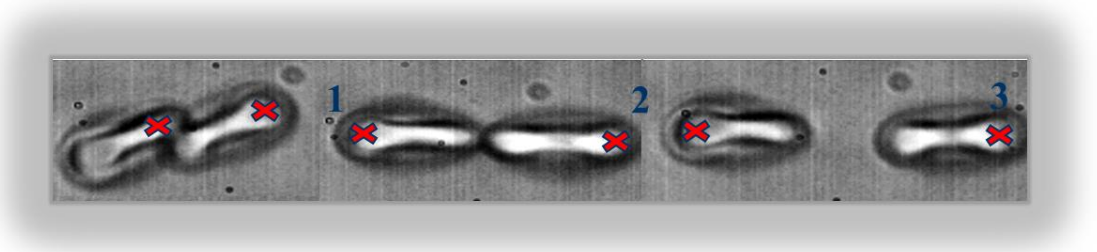

Figure 1. Illustration of the experiment, (1) – RBCs are brought intact with two-channels of optical tweezers and held in contact for a few seconds (overlapped for autologous plasma), (2) – One of the traps is moved to disaggregate the doublet, (3) – RBCs are fully disaggregated. Crosses show the position of the traps.

The results show that aggregation and disaggregation forces are not equal [1,2]. Typically the force to stop spontaneous aggregation is at the level of a few *pN*, whereas the force required to disaggregate the RBCs is about a few dozen of *pN*.

[1] K. Lee, A.V. Danilina, M. Kinnunen, A.V. Priezzhev, and I. Meglinski, "Probing the Red Blood Cells Aggregating Force with Optical Tweezers," *IEEE J. Sel. Top. Quantum Electron.*, 22(3): 7000106 (2016).
[2] K. Lee, M. Kinnunen, M. Khokhlova, E. Lyubin, A. Priezzhev, I. Meglinski, and A. Fedyanin, "Optical tweezers study of red blood cell aggregation and disaggregation in plasma and protein solutions," *J. Biomed. Opt.* (2016) // in press