Front microrheology of blood: relation between viscosity and red blood cells biomechanical properties

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Abstract:

Front Microrheology is a technique developed to track the velocity of the fluid-air interface inside a microfluidics channel and determine the viscosity of the fluid. We use this technique to study the rheological properties of blood. These properties of blood depend highly on the properties of its red blood cells concentration, membrane elasticity and aggregation. These properties affect the viscosity of blood, as well as its shear thinning behavior. Using front microrheology technique, we determine the viscosity of different samples of blood. We propose a model able to predict the health conditions of blood samples by introducing a specific coefficient taking into account the hematocrit and the biomechanical properties of the red blood cells. We present a method that successfully normalizes the viscosity of blood, according to the concentration of erythrocytes and their biomechanical properties, such as, bending elasticity and aggregation.

Recent Publications (minimum 5)

1. Trejo-Soto, C., Costa-Miracle, E., Rodríguez-Villarreal, I., Cid, J., Alarcon, T., & Hernández-Machado, A. (2016). Capillary filling at the microscale: Control of fluid front using geometry. *PLoS One*, *11*(4), e0153559.
2. Trejo-Soto, C., Costa-Miracle, E., Rodríguez-Villarreal, I., Cid, J., Castro, M., Alarcon, T., & Hernandez-Machado, A. (2017). Front microrheology of the non-Newtonian behaviour of blood: scaling theory of erythrocyte aggregation by aging. *Soft matter*, *13*(16), 3042-3047.
3. Lázaro, G. R., Hernández-Machado, A., & Pagonabarraga, I. (2014). Rheology of red blood cells under flow in highly confined microchannels: I. effect of elasticity. *Soft Matter*, *10*(37), 7195-7206.
4. Lázaro, G. R., Hernández-Machado, A., & Pagonabarraga, I. (2014). Rheology of red blood cells under flow in highly confined microchannels. II. Effect of focusing and confinement. *Soft matter*, *10*(37), 7207-7217.
5. Tomaiuolo, G. (2014). Biomechanical properties of red blood cells in health and disease towards microfluidics. *Biomicrofluidics*, *8*(5), 051501.

Image

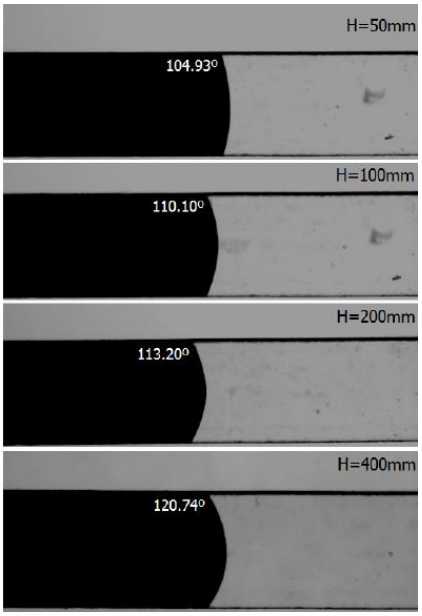


Figure 1: Real time image of the blood-air interface (blood front).

Biography

Claudia Trejo obtained her Ph.D. in Physics at the Universitat de Barcelona in 2016 where she worked with the group of Dynamics of interfaces in nanotechnology, fluidics and biophysics. Since 2018 she is developing her research at the Instituto de Física of the Pontificia Universidad Católica de Valparaíso where she is in charge of an international collaboration project with Barcelona and leads the Biorheology and Microfluidics Laboratory. Here with her group they develop experimental research in interface dynamics in microfluidics, hemorheology, red blood cells dynamics in confined geometries and mechanical properties of red blood cells. Currently, in collaboration with the Institute of Chemistry and the Medical Technology departament of PUCV, she is working on the development of Point of Care diagnostics techniques, relating the viscosity of blood with the mechanical properties of red blood cells.

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