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Stretching Behavior of Red Blood Cells at High Strain Rates

JORDAN MANCUSO, WILLIAM RISTENPART, Dept. Chemical Engineering, University of California Davis — Most work on the mechanical behavior of red blood cells (RBCs) has focused on simple shear flows. Relatively little work has examined RBC deformations in the physiologically important extensional flow that occurs at the entrance to a constriction. In particular, previous work suggests that RBCs rapidly stretch out and then retract upon entering the constriction, but to date no model predicts this behavior for the extremely high strain rates typically experienced there. In this work, we use high speed video to perform systematic measurements of the dynamic stretching behavior of RBCs as they enter a microfluidic constriction. We demonstrate that a simple viscoelastic model captures the observed stretching dynamics, up to strain rates as high as 1000 s^{-1}. The results indicate that the effective elastic modulus of the RBC membrane at these strain rates is an order of magnitude larger than moduli measured by micropipette aspiration or other low strain rate techniques.

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