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Measurement of red blood cell mechanics during morphological changes[1] GABRIEL POPESCU, University of Illinois at Urbana-Champaign, YONGKEUN PARK, MIT, CATHERINE BEST, UIUC, RAMACHANDRA DASARI, MICHAEL FELD, MIT, TATIANA KURIABOVA, University of Colorado, MARK HENLE, Harvard, ALEX LEVINE, UCLA — The human red blood cell (RBC) membrane, a fluid lipid bilayer tethered to an elastic 2D spectrin network, provides the principal control of the cell's morphology and mechanics. These properties, in turn, influence the ability of RBCs to transport oxygen in circulation. Current mechanical measurements of RBCs rely on external loads. Here we apply a Noncontact optical interferometric technique to quantify the thermal fluctuations of RBC membranes with 3 nm accuracy over a broad range of spatial and temporal frequencies. Combining this technique with a new mathematical model describing RBC membrane undulations, we measure the mechanical changes of RBCs as they undergo a transition from the normal discoid shape to the abnormal echinocyte and spherical shapes. These measurements indicate that, coincident with this morphological transition, there is a significant increase in the membrane's shear and bending moduli. This mechanical transition can alter cell circulation and impede oxygen delivery.

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