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Measurement of Fibrin Fiber Strength

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Platelets and a meshwork of fibrin fibers are the two major components of blood clots. Blood clots usually form in the event of injury or damage to blood vessels to prevent the loss of blood. Moreover, as we age, blood clots often form in undesired locations, i.e. in blood vessels around the heart or brain, or in uninjured vessels resulting in heart attacks or strokes. Fibrin fibers, the skeleton of a blood clot, essentially perform the mechanical task of creating a blockage that stems blood flow. Thus, a better understanding of the mechanical properties of these fibers will enhance our understanding of blood clots.

We are pursuing the measurement of the mechanical properties of fibrin fibers, including their tensile strength, Young's modulus and plasticity, under near-physiological conditions. For quantitative stress and strain measurements, we need to image the deformation of the fiber and measure the applied force simultaneously. For this reason, we are combining fluorescent microscopy with atomic force microscopy. Fibrin fibers were fluorescently labeled with streptavidin-coated quantum dots and deposited on a functionalized glass substrate without drying. Using an AFM tip, the fibers were strained to failure under physiological buffer solution while being monitored with optical microscopy. We have observed the elastic response of the fibers as they relax after AFM probe manipulation and stretching. We will describe our progress in obtaining quantitative lateral force measurements under buffer simultaneous with strain measurements from optical microscope image.