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Foam-like compression behavior of fibrin networks XIAOJUN LIANG, University of Pennsylvania, OLEG KIM, University of Notre Dame, RUSTEM LITVINOV, JOHN WEISEL, University of Pennsylvania, MARK ALBER, University of Notre Dame, PRASHANT PUROHIT, University of Pennsylvania — The rheological properties of fibrin networks have been of long-standing interest, especially shear and tensile responses. Their compressive behavior, however, remains unexplored. We show that the compressive behavior of fibrin networks consists of three regimes: 1) an initial linear regime, in which most fibers are straight, 2) a plateau regime, in which more and more fibers buckle and collapse, and 3) a markedly non-linear regime, in which network densification occurs by bending of buckled fibers and inter-fiber contacts. Importantly, the spatially non-uniform network deformation included formation of a moving phase boundary along the axis of strain, which segregated the fibrin network into two phases with different fiber densities and structure. The Young's modulus of the linear phase depends quadratically on the fibrin volume fraction while that in the densified phase depends cubically on it. The viscoelastic plateau regime corresponds to a change of volume fraction in mixture of these two phases. We model this regime using a continuum theory of phase transitions and analytically predict the storage and loss moduli. We show they are in good agreement with the experimental data. Our work shows that fibrin networks are a member of a broad class of natural cellular materials.

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