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Impact of a cylindrical rod on a concentrated particle suspension: dynamics, crack growth and relaxation EGLIND MYFTIU, MATTHIEU ROCHE, PILNAM KIM, HOWARD A. STONE, Mechanical and Aerospace Engineering, Princeton University — Many highly concentrated particle suspensions are shear thickening; the viscosity increases with shear rate. The physics underlying shear thickening is still under discussion. In recent years, it was pointed out that shear thickening may be connected with a liquid-to-solid phase transition of the suspension. We provide direct evidence of this transition by studying the behavior of aqueous cornstarch suspensions of various concentration and layer thicknesses after impact of a free-falling cylindrical rod, which induces high strain rates and stresses. We observe patterns of regularly distributed radial cracks growing outwards from the impact region. Just after impact, a wave propagates on the surface of the layer and in the neighborhood of the impact a cavity expands. During this expansion, the cavity boundary is torn, and cracks start to grow. These cracks have rough boundaries, as is seen in solids. Once the cracks have reached their maximal extension, the suspension relaxes. The solvent slowly fills the cracks, until the layer returns to its initial shape. We discuss the influence of the layer thickness, starch concentration and impact energy on the dynamics of these cracks. We also discuss some properties of the solid phase of these suspensions as well as their relaxation dynamics.

Howard A. Stone
Mechanical and Aerospace Engineering, Princeton University

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