207f Shear Thickening Fluids Reinforced by Discontinuous Short Fibers: Ballistic and Rheological Properties

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Colloidal shear thickening fluids (STFs) reinforced with discontinuous short-fibers are shown to exhibit improved shear thickening effects. Such new fluid composites are tested for ballistic performance and characterized with squeeze-flow rheology. Fiber properties such as length distribution, rigidity, and aspect ratio are examined to investigate how mechanical properties of STF-fiber composites can be enhanced for body armor applications. Fibers that are used to represent different types of fiber architectures include carbon fibers, glass fibers, and high-density polyethylene fibers. Ballistic performance is tested with a helium-powered gas gun and a clay witness, the latter of which is used to measure depth of penetration of the fragmentation simulation projectile (FSP). For some STF-fiber composites, the projectile is stopped inside the fluid and minimally penetrates the clay witness. Results from squeeze flow rheology, conducted on a strain-controlled rheometer and an Instron compression tester, correlate well with ballistic performance results, which make squeeze flow rheology a promising method to effectively screen for other novel composites.