Abstract Submitted
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High Rate Micromechanical Behavior of Grafted Polymer Nanoparticle Films[1] EDWIN THOMAS, Rice University — We report the ultra high strain rate behavior of films comprised of polymer grafted nanoparticles (NPs) and compare the results to homopolymer films. The films are formed by flow coating a suspension of polystyrene (PS) chains of 230 kg/mol grafted to 16nm diameter SiO_2 at a graft density of ˜0.6 chains/nm^2 resulting a film with 1 vol % SiO_2. Films of 267 kg/mol PS were also flow coated and both films were impacted at velocities 350-700 ms^{-1} using 3.7 micron SiO_2 projectiles to achieve increments in kinetic energy (KE) of 1:2:4. The KE of the projectiles before and after penetration was measured to determine the penetration energy. TEM and SEM suggest the projectile initially induces plastic flow due to the adiabatic temperature rise from impact. As the projectile deforms the film, the lower magnitude, biaxial stress state in the peripherial regions causes material microvoid formation and initiation of craze growth in the radial and tangential directions. The anchoring of the grafted polymer chains to the NPs increases the penetration energy relative to the pure homopolymer by 50% and the films capacity to delocalize the impact by 200%. These results suggest that highly grafted NP films may be useful in lightweight protection systems.

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