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Saturable Absorption of Shock Waves in Metal-Organic Framework XUAN ZHOU, University of Illinois — The large mechanical energy storage capacity of metal-organic frameworks (MOFs) has suggested their promising potential as shock protective armor materials. Here, we performed shock compression of MOF (ZIF-8) film to understand the shock attenuation mechanisms in MOFs and develop a method that predicts the output shock energy from different thicknesses of shock absorbing materials. The shock wave was generated from the impact of an aluminum flyer plate and ZIF-8 film. The flyer plate (500 μm diameter, 75 μm thick) was accelerated to 0.6-1.9 km/s by a flat-top pulsed laser. It impacted the ZIF-8 film of 4-110 μm thick after stabilizing its transient in vacuum. The shock wave propagated through the ZIF-8 film and reached an ultra-thin gold mirror, whose motion was tracked by a photon-Doppler velocimeter (PDV). By carrying out a post-mortem study, we found that the shock wave was absorbed by MOFs through powder compaction, nanopore-collapse, and chemical bond breakage that were activated at distinct shock energies. The PDV energy profiles shows that ZIF-8 films are 2.5-7 times more efficient than PMMA in shock energy absorption. We also found that the shock wave energy follows a saturable absorption trend over the shock propagation distance in the material.

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