Protective structures with waiting links and their damage evolution

Liya Zhornitskaya

Department of Mathematics
University of Utah

Abstract

The talk concerns protective structures that exhibit an unusually high dissipation when they are subject to a concentrated (ballistic) impact. Such a structure is defined as an assembly (network) of rods connected in knots and submerged into a viscous substance. During the hit, the kinetic energy of the projectile must be absorbed in the structure; the structure fails if it is unable to absorb the energy. While theoretically a material can absorb energy until it melts, real structures are destroyed by a tiny fraction of this energy due to material instabilities and an uneven distribution of the stresses throughout the structure. We want to find a structure that absorbs maximal kinetic energy of the projectile without rupturing or breaking. The increase of the stability is achieved due to special structural elements, "waiting links." These elements contain parts that are initially inactive and start to resist when the strain is large enough; they lead to large but stable pseudo-plastic strains. Structures with "waiting links" distribute the strain over a large area, in contrast to conventional unstructured solids in which the strain is concentrated near the zone of an impact.