MAR12-2011-002524

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Strain-stiffening in random packings of entangled granular chains[1]

ERIC BROWN, University of California, Merced

Random packings of granular chains are presented as a model polymer system to investigate the consequences of entanglements in the absence of Brownian motion. The packings are compressed uniaxially and the structure is characterized by x-ray tomography. For short chain lengths, these packings yield when the shear stress exceeds the scale of the confining pressure, similar to packings of spherical particles. In contrast, packings of chains which are long enough to bend into closed loops exhibit strain-stiffening, in which the effective stiffness of the material increases with strain, similar to many polymer materials. The latter packings can sustain stresses orders-of-magnitude greater than the confining pressure, and do not yield until the chain links break. These strain-stiffening packings are found to contain system-spanning clusters of entangled chains.

[1]This work was done with Alice Nasto, Athanasios G. Athanassiadis, and Heinrich M. Jaeger at The University of Chicago