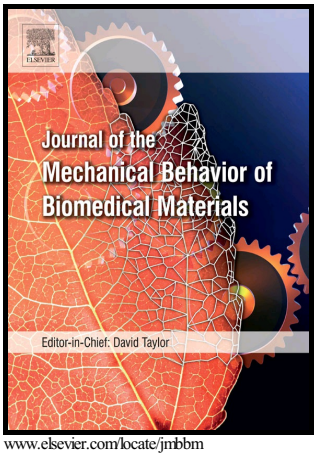
High-velocity micro-particle impact on gelatin and synthetic hydrogel

David Veysset, Steven E. Kooi, A.A. Maznev, Shengchang Tang, Aleksandar S. Mijailovic, Yun Jung Yang, Kyle Geiser, Krystyn J. Van Vliet, Bradley D. Olsen, Keith. A. Nelson



www.elsevier.com/locate/jmbbm

PII: S1751-6161(18)30473-9
DOI: https://doi.org/10.1016/j.jmbbm.2018.06.016
Reference: JMBBM2837

To appear in: *Journal of the Mechanical Behavior of Biomedical Materials*

Received date: 9 April 2018
Revised date: 29 May 2018
Accepted date: 9 June 2018

Cite this article as: David Veysset, Steven E. Kooi, A.A. Maznev, Shengchang Tang, Aleksandar S. Mijailovic, Yun Jung Yang, Kyle Geiser, Krystyn J. Van Vliet, Bradley D. Olsen and Keith. A. Nelson, High-velocity micro-particle impact on gelatin and synthetic hydrogel, *Journal of the Mechanical Behavior of Biomedical Materials,* https://doi.org/10.1016/j.jmbbm.2018.06.016

High-velocity micro-particle impact on gelatin and synthetic hydrogel

David Veysset[a,b,*], Steven E. Kooi[a], A. A. Maznev[a,b], Shengchang Tang[c], Aleksandar S. Mijailovic[d], Yun Jung Yang[c], Kyle Geiser[e], Krystyn J. Van Vliet[e], Bradley D. Olsen[a,c], and Keith. A. Nelson[a,b]

[a]Institute for Soldier Nanotechnologies, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
[b]Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
[c]Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
[d]Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
[e]Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA

[*]Correspondence to author. dveysset@mit.edu (D. Veysset)

Abstract

The high-velocity impact response of gelatin and synthetic hydrogel samples is investigated using a laser-based microballistic platform for launching and imaging supersonic micro-particles. The micro-particles are monitored during impact and penetration into the gels using a high-speed multi-frame camera that can record up to 16 images with nanosecond time resolution. The trajectories are compared with a Poncelet model for particle penetration, demonstrating good agreement between experiments and the model for impact in gelatin. The model is further validated on a synthetic hydrogel and the applicability of the results is discussed. We find the strength resistance parameter in the Poncelet model to be two orders of magnitude higher than in macroscopic experiments at comparable impact velocities. The results open prospects for testing high-rate behavior of soft materials on the microscale and for guiding the design of drug delivery methods using accelerated microparticles.