Abstract Submitted
for the SHOCK19 Meeting of
The American Physical Society

Fast X-ray radiography to study the dynamic compaction mechanisms in a rigid polyurethane foam under plate impact PIERRE PRADEL, FREDERIC MALAISE, CEA CESTA, France, THIBAUT DE RESSEGUIER, Institut Pprime, France, MARGIE OLBINADO, ALEXANDER RACK, European Synchrotron Radiation Facility, France, DANIEL EAKINS, University of Oxford, United Kingdom — Polymeric foams are widely used in many industrial fields as structural materials or shock wave mitigators. They would be valuable candidates to protect structures against intense mechanical stress wave loadings generated by laser irradiation or high velocity impact of very small debris. This article presents the results of plate impact experiments coupled to in situ X-ray radiography, performed on a polyurethane foam, to visualize its deformations during the propagation of a stress wave. A two-wave structure associated with the propagation of an elastic precursor and the compaction of the pores has been observed. A phenomenological compaction model, implemented in a dynamic explicit one-dimensional hydrocode, was used to simulate the dynamic macroscopic response of the foam. By using this model, which has previously been calibrated and validated by performing dedicated dynamic experiments, it is possible to compare calculated and experimental waves velocities and improve interpretations. Quasi-static tests coupled to in situ X-ray tomography have also been performed to study the mechanical behavior under low strain rates. Contrary to dynamic experiments, where the cells are crushed by brittle failure of the matrix, the quasi-static compaction of the foam is governed by elastic bending and buckling of the cell edges.

Pierre Pradel
CEA CESTA, France

Date submitted: 22 Feb 2019 Electronic form version 1.4