Plastic compacting of porous metals:md modeling and machine learning

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We apply a two-level approach to the study of the mechanical behavior of porous metals under dynamic deformation. At the microscopic level, using the molecular dynamics (MD) method, the effect of high-speed compressive strain on porous aluminum has been studied. Stress-strain, porosity-strain and density of dislocation-strain curves will be calculated in the range of temperatures from 300 to 900 K for various pore sizes. Data for comparison were obtained for hydrostatic and uniaxial compression of representative bulk elements of an aluminum single crystal with spherical, cubic, and cylindrical nanopores. At the macroscopic level, we compared two machine learning-based approaches, an artificial neural network (ANN) [1] and a micromechanical model described in [2] with automatic Bayesian identification of model parameters, applied to simulate the deformation behavior of nanoporous aluminum extracted from MD simulations. Both approaches based on machine learning can be additionally applied as constitutive equations for nanoporous metals in macroscopic modeling of dynamic compaction and shock wave processes in this material.

This work was supported by the Russian Foundation for Basic Research (Project 20-38-90209 and 20-08-00350) and the Ministry of Science and Higher Education of the Russian Federation (State Assignment for Research CSU 075-03-2022-126).

[1] Gracheva N A, Lekanov M V, Mayer A E and Fomin E V 2021 *Mech. Solids* **56** 326–342

[2] Mayer A E 2021 *Int. J. Plast.* **147** 103102