Conformational and Mechanical Properties at High Strain Rates

William G. Hoover

University of California, Davis

N/A

DAAG29-82-K-0022

Mar 85

5

Approved for public release; distribution unlimited.

Mechanical Properties
Strain Rates
Plastic Flow
Plasticity

We have developed several powerful means of studying steady flows far from equilibrium. Gauss' Principle (minimizing the forces of constraint) was found to be useful for most problems, but leads to (small, 10%) errors when applied to heat flow simulations.
20. ABSTRACT CONTINUED:

We have discovered corresponding-states relations for the rate-dependent viscosity and flux-dependent heat conductivity which are useful in making macroscopic constitutive-equation estimates.

Additional keywords:
- mechanical properties
- plastic flow
- plasticity
- power-compaction
- fracture properties
- strong materials

Accession For

<table>
<thead>
<tr>
<th>NTIS GRAAI</th>
<th>DTIC TAB</th>
<th>Unannounced</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By

Distribution/

Availability Codes

<table>
<thead>
<tr>
<th>Dist</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td></td>
</tr>
</tbody>
</table>

85 4 08 067
Final Report to
United States Army Research Office
Research Triangle Park, North Carolina

Project Title: Conformational and Mechanical Properties at High Strain Rates

Period Covered by Report: 7 Dec 81 - 30 Apr 85

Grant: DAAG29-82-K-0022

Proposal Number: 18611-EG

Scientific Personnel Supported: William G. Hoover, Principal Investigator
J. Andrew Combs
Anthony J. C. Ladd
Carlo Massobrio

Contents

<table>
<thead>
<tr>
<th>Problem Studied</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary of Results</td>
<td>3</td>
</tr>
<tr>
<td>Related Publications</td>
<td>4</td>
</tr>
</tbody>
</table>

Submitted by: William G. Hoover
Problem Studied

As stated in our proposal of 2 April 1981, "Conformational and Mechanical Properties at High Strain Rates," fundamental knowledge of high-speed deformation is very limited. We have provided new insights both on the microscopic atomistic level and at the macroscopic level of constitutive modelling.

During our 42-month study we have analyzed the plastic flow of solids (1, 2, 3) reviewed and developed new simulation methods for studying mass, momentum, and energy flows (4, 5, 6, 7, 8, 9). We have considered the macroscopic aspects of plasticity, fracture, and powder compaction (10, 11, 12). We have begun an extension of these ideas to molecular systems (13) and have considered the technical aspects of some simple problems in elasticity (14, 15). We have most recently studied heat flow simulation in fluids and solids (16).
Summary of Results

We have developed several powerful means of studying steady flows far from equilibrium. Gauss' Principle (minimizing the forces of constraint) was found to be useful for most problems, but leads to (small, 10%) errors when applied to heat flow simulations.

We have discovered corresponding-states relations for the rate-dependent viscosity and flux-dependent heat conductivity which are useful in making macroscopic constitutive-equation estimates.

We have stimulated considerable interest in this area through a series of review articles and through participation in and organization of several international meetings and schools* covering these areas.

Orsay CECAM Workshops at Orsay (1983-5)
Euratom Course at Ispra (1984)
Enrico Fermi School of Physics at Varenna (1985)
Related Publications


