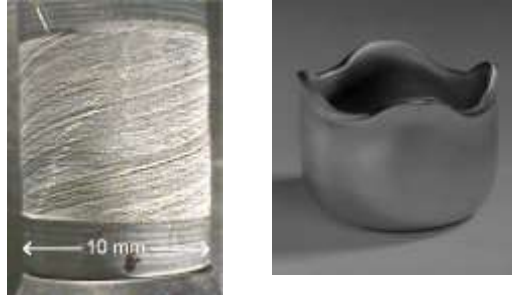


Information about the Lecture

Nonlinear Continuum Mechanics



Plastic torsion (left) Deep drawing of a cup (right)

Content of the Lecture

The lecture conveys the fundamentals of the kinematics of finite deformations. In addition, balance equations for volumes with singular surfaces are introduced in a general form and specified for typical applications. Based on a general description of the principles of material theory, the constitutive equations, e.g., for thermoelasticity and thermoviscoplasticity, are derived. For this purpose, the dissipation inequality is evaluated. Thermomechanical coupling effects are discussed. With the knowledge taught in this lecture, students are able to apply the principles of material theory to cases of geometrically and physically nonlinear continuum mechanics.

Dates, Exam, Lecture Notes

Lecture	Mo, 11:30-13:00, Bldg. 10.81, Theodor-Rehbock-Seminar Room (HS59)
Lecture start	Mo, 20.04.2026
Exam	Oral
Lecture structure	Lecture 2 SWS, Tutorial 1 SWS / 4CP
Contact	Prof. Dr.-Ing. Thomas Böhlke M.Sc. Frederik Hille, M.Sc. Claudius Klein
Course Material	Available on ILIAS

Literature

- [1] Truesdell, C., Noll, W.: *The Non-Linear Field Theories of Mechanics*, Springer 2004.
- [2] Liu, I-S.: *Continuum Mechanics*, Springer 2002.
- [3] Silhavy, M.: *The Mechanics and Thermodynamics of Continuous Media*, Springer 1997.
- [4] Krawietz, A.: *Materialtheorie*, Springer, 1986.
- [5] Gurtin, M., Fried, E., Anand, L.: *The Mechanics and Thermodynamics of Continua*, Cambridge University Press 2010

Content of the lecture

- **Kinematics**

Motion; Eulerian and Lagrangian descriptions of field quantities; material time derivative; deformation gradient; transformations of line, surface, and volume elements; polar decomposition of the deformation gradient; generalized strain measures; and kinematic compatibility conditions.

- **Balance Equations**

Inertial frames; general structure of balance equations; transport theorem; local form of the balance equations at regular points; jump conditions; Eulerian and Lagrangian forms of the balance equations; implications of the second law of thermodynamics at regular points and at points on a singular surface.

- **Principles of Material Theory**

Constitutive equations; dependent and independent variables; state variables and internal variables; symmetry transformation of a constitutive function; change of configuration and observer; dependence on kinematic properties; principle of local action; material objectivity; simple materials; gradient materials.

- **Discussion of Special Material Classes**

Rigid heat conduction, elasticity, thermoelasticity, rigid viscoplasticity, elastoviscoplasticity, and thermo-elastoviscoplasticity. Discussion of Special Material Classes