

Module BIW-MA-AC-E-08: Multiscale Mechanics

Contents

- Introduction
 - Definition of different material scales
 - Main procedure of multiscale mechanics
- Some basics in the mechanics of solid continua
 - Tensor calculus
 - Theory of elasticity (Voigt's matrix notation, material symmetries, plane strain and plane stress conditions, ...)
- Fundamental concepts of multiscale mechanics
 - Averaging of stresses and strains
 - Hill's energy condition and resulting boundary conditions
 - Overall (effective) elastic properties
- Elastic solids with traction-free defects
 - Average strain for prescribed macrostress and overall compliance tensor
 - Average stress for prescribed macrostrain and overall elasticity tensor
 - Overall elastic moduli of solids with traction-free defects
 - Dilute distribution and self-consistent estimate
 - Discussed examples:
 - Elastic plate containing circular holes
 - Elastic body containing spherical cavities
 - Elastic plate containing aligned slit microcracks
 - (Elastic plate containing randomly distributed slit microcracks)
- Elastic solids with microinclusions
 - Eigenstrain and eigenstress tensors
 - Eshelby's tensor
 - Overall elastic moduli of solids with microinclusions
 - Dilute distribution and self-consistent estimate
 - Discussed examples:
 - Elastic solid containing randomly distributed spherical microinclusions
 - Elastic solid containing aligned reinforcing fibers
- Concluding remarks

Prerequisite Knowledge

Good Knowledge from the module 'Continuum Mechanics and Tensor Calculus' as well as basics of fracture mechanics from the module 'Building Materials' in the first semester are required.

Literature

S. Nemat-Nasser, M. Hori: Micromechanics – Overall Properties of Heterogeneous Materials, Elsevier Science Ltd.

Project and Master Thesis

Please contact the Institute of Mechanics and Shell Structures for possible topics.