

# Christian F. Niordson

## “Size-effects in damage and fracture of metals”

Micron scale size-effects in metals have been confirmed in numerous experiments, exhibiting the general trend that smaller is stronger. For torsion of micron scale wires and bending of thin films, it has been found that normalized twisting and bending resistance in the plastic deformation range increase with decreasing specimen size. In micro- and nano-indentation testing increased hardness for smaller indentations are measured. It is generally accepted these size-effects in metals are due to so-called geometrically necessary dislocations that arise in the presence of very large plastic strain gradients. Such gradients may be imposed due to inhomogeneous overall deformation as in the examples above, but they can also arise under homogeneous deformation when boundaries are passivated, such that plastic deformation is hindered due to blockage of dislocations.

In this presentation a brief overview of experimental results on micron scale metallic specimens is given. A mathematical basis for modeling methodologies based on higher order continuum mechanics will be presented, together with a discussion on numerical methods. A few basic solutions will be illustrated, and size-effects in metals will be discussed and analyzed in relation to void growth in metals and ductile fracture.



Christian F. Niordson is professor at the Department of Mechanical Engineering at the Technical University of Denmark (DTU), where he is also the head of the section for Solid Mechanics. He holds a MSci and PhD from the DTU.

He is a committee member of the European Solid Mechanics Conference Committee (ESMCC) and of many other organizations. From 2011 to 2014 he was the Chairman of DCAMM - 'Danish Center for Applied Mathematics and Mechanics'. He is on the board of editors for 'International Journal of Solids and Structures'.

He had extended research visits at Harvard University with Professor John W. Hutchinson, and at Columbia University with Professor Jeffrey W. Kysar.

Christian F. Niordson is author or co-author of 59 peer-reviewed journal publications.