Examensarbete

Avdelningen för Mekanik

Fatigue of pre-cracked metallic fcc nano-beams under varying temperature

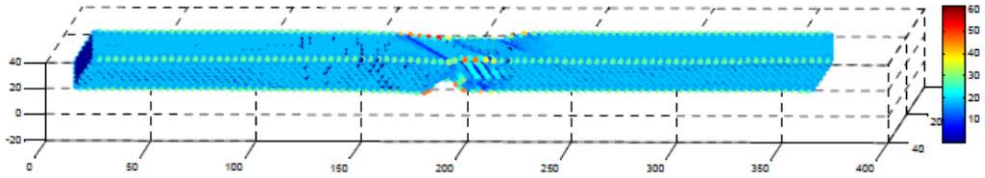

Figure: Damage accumulation close to a pre-existing crack in a single crystal copper nano-beam. Each point corresponds to one atomic position. Note the different scaling along the axes. Measures in Å.

With decreasing component size follows the necessity of re-visiting traditional dimensioning criteria, established for structures at the macro-scale. This is because of the well-known fact that the mechanical properties of metals become size-dependent for small enough structures, with linear measures at the nanometer-scale. This influence from size has been experimentally demonstrated for a number of materials and load situations and emerges at component dimensions somewhere below 100nm.

This project aims at determining the resistance against fatigue failure of pre-cracked nano-sized single crystal metallic fcc beams using 3D molecular dynamics simulations. The reason for the urgency of this project, and similar investigations directed towards finding dimensioning criteria at the nano-scale, rests on the well-known fact that mechanical properties of nano-sized structures, elastic as well as plastic, differ from what is found on the macro-scale. Thus dimensioning rules at the nano-scale are bound to differ from common handbook recommendations for large structures. This applies to all loading situations and, of course, also to fatigue in general and fatigue under varying temperature in particular. These issues are addressed in this thesis work.

This MSc thesis work addresses the influence from fatigue loading on nano-sized pre-cracked structures. The modelling will be performed through 3D molecular dynamics simulations and the results will be compared to what applies to the macroscopic scale, found from traditional solid mechanics calculations.

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