

IFMASS 10 Lecture 2

ANALYSIS OF CRACK EXTENSION AT MESO- AND NANO-LEVELS

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ABSTRACT

Some examples of applications of Fracture Mechanics in space engineering will be given. Case study will focus on latent fractures occurring in MEMS and other novel structural components that involve use of the nano-components.

Emergence of new material components such as nanotubes, nanobelts, nanodisks, nanowires, nanocoils, nanocoatings and nanostructured materials involving nanocrystals and nanocomposites has necessitated active research that reaches beyond the classic version of Fracture Mechanics. It requires that new approaches are employed at the interface of Physics, Mechanics and Materials Science.

One such possible approach is an atomistic model of fracture, in which an approach similar to Quantum Mechanics method known in Physics is employed. The concepts of Neuber particle, the process zone, Wnuk's unit step of growth, Novozhilov's finite characteristic material length constant and Pugno's fracture quantum will be presented and discussed in the context of applications of Fracture Mechanics in Nano-Engineering. This is so-called QFM, which stands for Quantized Fracture Mechanics. Scaling problems and size effects will also be subject to the discussion.

Certain aspects of the cohesive models of fracture and implications of fractal nature of cracks, as opposed to mathematically smooth cracks, will also be considered.