Numerical simulation of failure and plasticity at various scales in quasi-brittle materials

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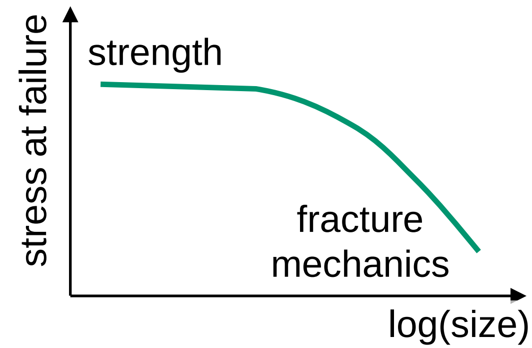

Fig.1: Size effect

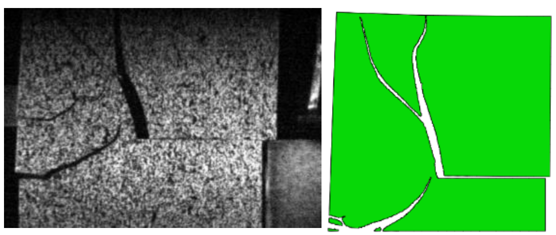

Fig.2: Experiments vs Phase-field fracture (Kalthoff test)

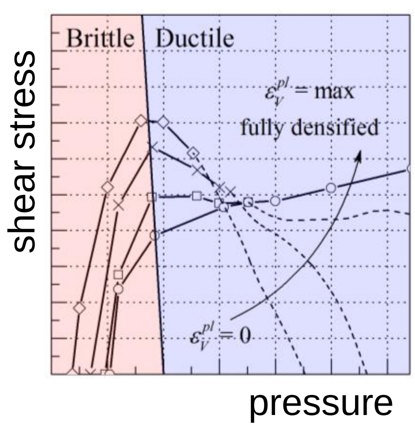

Fig.3: Failure criterion in MD

The seminar focuses on the size effect observed when measuring the strength of brittle materials at different length scales. As shown in Fig.1, if the sample is small or flawless, the resistance can be determined using a stress-based criterion. However, if a significant defect is present, the stress singularity makes it necessary to consider the issue using fracture mechanics.

In the first part of the talk, the basics of the phase-field method will be introduced to solve fracture mechanics problems with variational approaches (Fig.2). While the second part presents a comprehensive numerical study on silicate glasses at the atomic scale. Our analysis focuses on local plastic deformation to deduce macroscopic yield criteria for different glass compositions (Fig.3). The project focuses on understanding the transition between ductile deformation and macroscopic fracture in these materials.

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