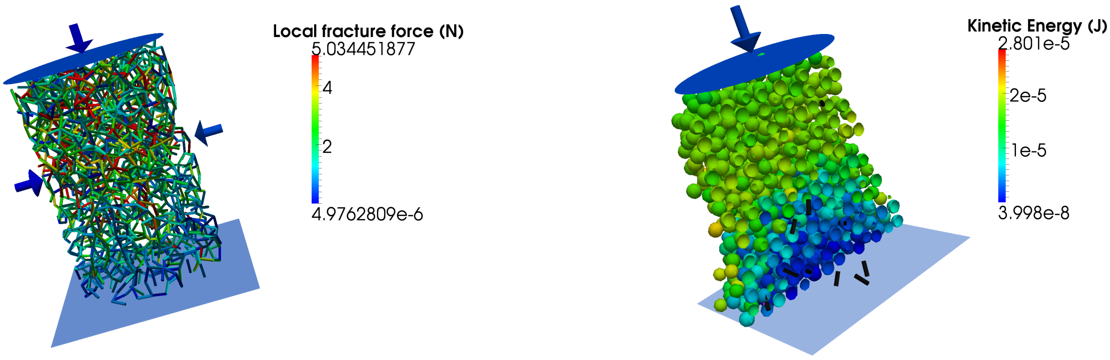
a damping function for fracture energy dissipation, u_f is a displacement limit depending on the fracture energy. The shear force, bending and torsion torques are computed according to the Euler-Bernoulli beam theory with a quasi-brittle failure and fracture energy dissipation to explicitly account for phase change.

3. Results and remarks

The micro-scale model allowed us to carry out detailed analysis of high strain and rate-dependent behavior and microstructure based fracture parameters. The following images show created microbeam structure under an isotropic compression and the flow of a granular phase after failure of the microbeam structure under high strain rate uni-axial compression. The Fracture force is calculated by multiplying the area of the created bond to the ultimate tensile strength of ice. The solid phase is characterized by the presence of microbeam. Under high



(a) (b)

Figure 1: *Tests at -5^oC a) Tensile force required to fracture local microbeam structure after a moderate strain rate isotropic compression; b) ongoing damage under high strain rate loading.*

strain rate the brittleness of snow and granular phase is characterized by fracture and low microbeams density.

4. Conclusion

In an effort to simulate the flow of granular snow and fracture behavior of packed snow during large deformations, a hierarchical approach consisting of micro-scale characterization, meso-mechanical and macro-mechanical modeling have been adopted. Based on creep tests and grains bonding strength measurements, calibration and validation of the grain scale mechanical model was performed and meso-scale fracture behavior was investigated. Also mechanical behavior under high strain and different strain rates and pressure sintering of snow have been investigated and modeled.

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