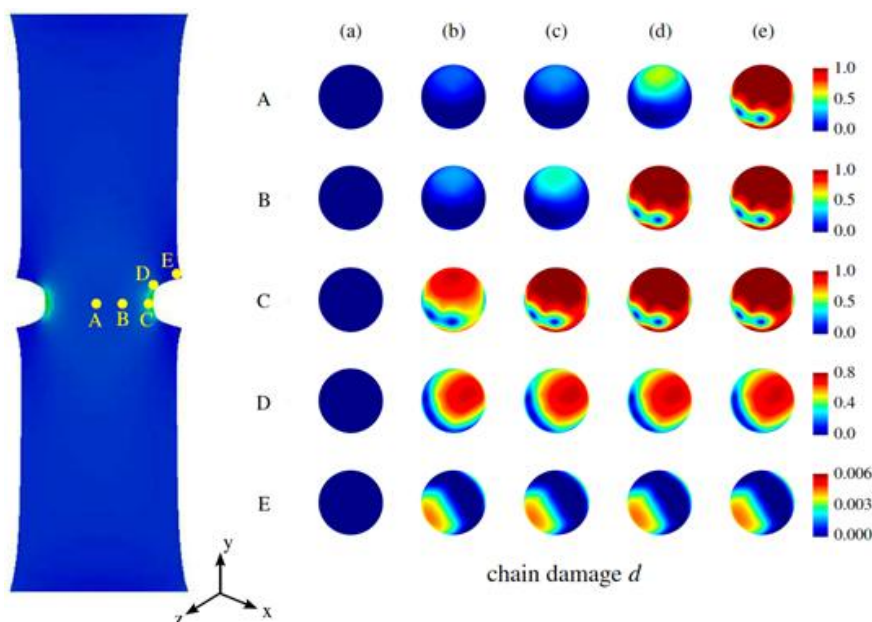


Christian Linder

“A Multiscale Phase-field Formulation to Model the Fracture Behavior of Strain-Crystallizing Polymers”

Polymers such as rubber-like materials are renowned for their exceptional properties, making them suitable for diverse applications. Consequently, accurately modeling their fracture behavior is crucial for ensuring the reliability and longevity of these applications. However, modeling the fracture behavior of rubbers poses significant challenges due to the need to incorporate their intricate microscale polymer network properties. This complexity is particularly pronounced in materials like natural rubber, which exhibit superior toughness compared to other rubbers, largely due to microscale phenomena such as strain-induced crystallization. To address these necessities and challenges, this work presents a comprehensive multiscale model aimed at accurately predicting the fracture behavior of strain-crystallizing rubbers while also being applicable to non-crystallizing rubbers. At the microscale, non-Gaussian statistics is employed to model the entropic chain behavior while also accounting for internal energy due to molecular bond distortions and the evolution of crystallites. The non-affine microsphere model, adapted for damaged systems, is utilized to bridge deformations across the two scales. At the macroscale, the phase field approach is employed to model damage, assumed to result primarily from the failure of microscale chain segments, while the evolution of crystallinity is posited to hinder this damage process. The model's effectiveness is validated through comparisons with experimental data, demonstrating its robust performance and accuracy in predicting fracture behavior.



Professor Christian Linder is the principal investigator of the Computational Mechanics of Materials Lab at Stanford University. He received his Ph.D. in Civil and Environmental Engineering from UC Berkeley, an M.A. in Mathematics from UC Berkeley, an M.Sc. in Computational Mechanics from the University of Stuttgart, and a Dipl.-Ing. degree in Civil Engineering from TU Graz. Before joining Stanford in 2013, he was a Junior-Professor of Micro-mechanics of Materials at the Applied Mechanics Institute of Stuttgart University, where he also obtained his Habilitation in Mechanics. Notable honors include a Fulbright scholarship, the 2013 Richard-von-Mises Prize, the 2016 ICCM International Computational Method Young Investigator Award, the 2016 NSF CAREER Award, and the 2019 Presidential Early Career Award for Scientists and Engineers (PECASE).