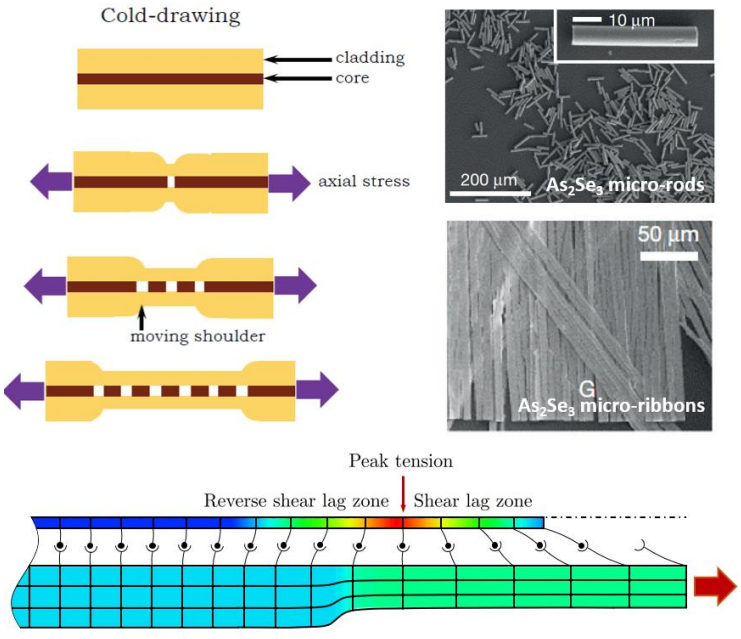
KTH SOLID MECHANICS KEYNOTE SEMINAR; Thursday, September 23rd, 16.15; https://kth-se.zoom.us/j/65509286036

Huajian Gao' KEYNOTE seminar "Theory of controlled fragmentation in cold drawing: towards a mechanics-based technological platform for large-scale manufacturing of structures at the micro- and nanoscale"

Cold drawing is a mature and widely adopted technique in the shaping of metallic and polymeric materials in industry. Interestingly, cold drawing of a ductile cladding containing a brittle core wire or a ductile substrate with a deposited brittle film has recently emerged as a method to produce micron sized rods and ribbons through controlled fragmentation induced by local necking. While this method shows potential in providing an economic yet efficient technological platform for large-scale manufacturing of structures at the micro- and nanoscale, there is so far no theoretical guideline on how to control the size of the fragmented components. Here, we develop a theory of controlled fragmentation in cold drawing of both axisymmetric core-cladding and plane-strain film-substrate systems. The theory reveals that the process is governed by a reverse shear lag effect which gives rise to a peak tensile stress leading to controlled fragmentation near the necking zone. Of particular interest is that the fragmentation size is predicted to depend on the interfacial shear strength, geometrical dimension and stiffness of the brittle material, and therefore can be reduced via increasing the strength of interfacial interactions and/or decreasing geometrical dimensions such as the core radius or film thickness.



Huajian Gao received his B.S. degree from Xian Jiaotong University in 1982, and his M.S. and Ph.D. degrees in Engineering Science from Harvard in 1984 and 1988, respectively. He served on the faculty of Stanford from 1988-2002, as Director at the Max Planck Institute for Metals Research from 2001-2006 and as Walter H. Annenberg Professor of Engineering at Brown from 2006-2019. At present, he is a Distinguished University Professors at Nanyang Technological University and Scientific Director of the Institute of High Performance Computing in Singapore. Professor Gao's research has been focused on the understanding of basic principles that control mechanical properties and behaviors of materials in both engineering and biological systems. He is the Editor-in-Chief of Journal of the Mechanics and Physics of Solids. His list of honors includes election to National Academy of Sciences and National Academy of Engineering in USA, and numerous awards such as the Timoshenko Medal.