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Effect of system compliance on crack nucleation in soft materials
SHRUTI RATTAN, ALFRED CROSBY, UMass Amherst — Puncture mechanics in soft materials is critical for the development of new surgical instruments, robot assisted-surgery as well as new materials used in personal protective equipment. However, analytical techniques to study this important deformation process are limited. We have previously described a simple experimental method to study the resistive forces and failure of a soft gel being indented with a small tip needle. We showed that puncture stresses can reach two orders of magnitude greater than the material modulus and that the force response is insensitive to the geometry of the indenter at large indentation depths. Currently, we are examining the influence of system compliance on crack nucleation (e.g. puncture) in soft gels. It is well known that system compliance influences the peak force in adhesion and traditional fracture experiments; however, its influence on crack nucleation is unresolved. We find that as the system becomes more compliant, lower peak forces required to puncture a gel of certain stiffness with the same indenter were measured. We are developing scaling relationships to relate the peak puncture force and system compliance. Our findings introduce new questions with regard to the possibility of intrinsic materials properties related to the critical stress and energy for crack nucleation in soft materials.

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