Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

**Rupture of a highly stretchable acrylic dielectric elastomer** GEORGE PHARR, Harvard University, JEONG-YUN SUN, Seoul National University and Harvard University, ZHIGANG SUO, Harvard University — Dielectric elastomers have found widespread application as energy harvesters, actuators, and sensors. In practice these elastomers are subject to large tensile stretches, which potentially can lead to mechanical fracture. In this study, we have examined fracture properties of the commercial acrylic elastomer VHB 4905. We have found that inserting a pre-cut into the material drastically reduces the stretch at rupture from $\lambda_{rup} = 9.43 \pm 1.05$ for pristine samples down to only $\lambda_{rup} = 3.63 \pm 0.45$ for the samples with a pre-cut. Furthermore, using "pure-shear" test specimens with a pre-crack, we have measured the fracture energy and stretch at rupture as a function of the sample geometry. The stretch at rupture was found to decrease with sample height, which agrees with an analytical prediction. Additionally, we have measured the fracture energy as a function of stretch-rate. The apparent fracture energy was found to increase with stretch-rate from $\Gamma \approx 1500$ J/m$^2$ to $\Gamma \approx 5000$ J/m$^2$ for the investigated rates of deformation. This phenomenon is due to viscoelastic properties of VHB 4905, which result in an apparent stiffening for sufficiently large stretch-rates.

George Pharr
Harvard University

Date submitted: 11 Nov 2011 Electronic form version 1.4